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NEW OR INTERESTING TROPICAL AMERICAN DOTHIDEALES—II.

by

CARLOS E. CHARDON

LIFE HISTORY OF LIGNIERA VASCULARUM (Matz) Cook

by

MELVILLE T. COOK

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NEW OR INTERESTING TROPICAL AMERICAN DOTHIDEALES—II *

CARLOS E. CHARDON

(WITH PLATES I AND II)

Since the publication by the writer (1) of the first paper on the Dothideales, a renewed interest in this group has been aroused due to the fact that Doctor H. Sydow of Berlin has expressed his intention of revising his well known monograph on the group (5) which is indeed in great need of revision, especially in regard to the Tropical American species.

The present paper, in the writers opinion, is a further evidence that such a revision is imperative. The critical study of the grass forms occurring in Porto Rico and Santo Domingo has proved to be suprisingly interesting and a number of forms which had been determined and reported in the work of Seaver and Chardon (3), after comparing with authentic type material or with forms already known from the continent, has turned out to be either species new to science, or else they have been referred to continental species. On the contrary, species like *Pyllachora Eriocholae* Speg. which had been reported as occurring in Porto Rico and Santo Domingo, have been eliminated from the flora of both islands.

If such a chaotic situation has prevailed in our knowledge of the Dothideales of Porto Rico, an island which has been so thoroughly explored by a dozen mycologists in the past fifteen years and the collections of which have been critically studied by the best American specialists in the different groups, the rest of tropical America no doubt offers, as it was previously stated "a vast field of investigation for systematic mycologists."

An additional paper by the writer (2), although not part of this series, has also appeared in which a number of new Phyllachorae have been described from Colombia. These were collected by the writer in the region of the Central Andes and along the banks of the Magdalena River in 1926.

The species herein described as new or interesting have been collected by various mycologists and by the writer in Porto Rico and deposited in part in the writer's personal herbarium; by Doctor

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* For the first contribution see Mycologia 19: 295–301. 1927.

F. D. Kern and Mr. R. A. Toro in Santo Domingo in 1926; by Mr. R. A. Toro, who has lately been stationed in Medellín, Colombia; and material from various collectors of the U. S. Department of Agriculture from South America, which has been kindly communicated for study by Mr. John A. Stevenson, in charge of the mycological collection in the Bureau of Plant Industry, Washington, D. C. To all of these collectors the writer wishes to express his indebtedness.

Seaver (4) in a recent publication has also given some attention of species of *Phyllachora* from Tropical America. His use of the name *Phyllachora* "in a broad sense" may seem somewhat objectionable to those of us who have accepted Theissen and Sydow's classification of the group.

An expression of appreciation is also due to Doctor H. Sydow, of Berlin, for kindly supplying type material and to Don Mario Brau, of the Museum of the Department of Agriculture of Porto Rico for the colored plates accompanying the paper.

DOTHIDEACEAE.

BAGNISIOPSIS TIJUCENSIS Theiss et Syd., Annal. Mycol. **13**: 291. 1915.

Two specimens from Colombia collected by R. A. Toro are referred to this species, which was only previously known from near Río de Janeiro, Brazil. The stromata showed the characteristic dothideoid and erumpent character of *Bagnisiopsis*. Spores 1-celled, hyaline, uniseriate in the ascus, elliptical, 13–14 × 5–6 u, which are slightly smaller than the description given by Theissen and Sydow.

On *Tibouchina longifolia* (Vahl.) Baill.

COLOMBIA: R. A. Toro No. *264*, Guarnes, Dept. of Antioquia, Nov. 3, 1927; R. A. Toro, No. *303*, near Medellin, Dept. of Antioquia, Jan. 20, 1928.

Achorella Toroana Chardon spec. nov.

Spots approximately circular, or irregular through coalescence, very conspicuously epiphyllous with the borders limited by a violet tinge, sometimes hypophyllous; stromata dothideaceous, warty, erumpent, black, mostly multiloculate, the locules globose or slightly irregular through lateral pressure, 350–400 × 250–300 u, the walls of the stroma when placed in water dissolving into a very conspicuous greenish blue substance; asci cylindrical, 8-spored, with the spores early evanescent from the asci, 158–172 × 11–15 u; spores 2-celled, distinctly brown, provided with a distinct cell wall, uniseriate in the ascus, 23–26 × 9–11; paraphyses present.

This is a very interesting new form: the stroma is evidently dothideaceous, resembling a *Bagnisiopsis* or a *Dothidina,* but the 2–celled, brown character of the spores makes it fall in the genus *Achorella.* The fungus is unique in tha the walls of the stroma when placed in water for examination under the miscrcoscope, secrete an opaque, greenish blue substance.

The species is dedicated to its collector, Mr. Rafael A. Toro, Porto Rican mycologist, now in Medellin, Colombia.

On *Cavendishia* Spec.

COLOMBIA: R. A. Toro, No. *260,* Guarnes, Dept. of Antioquia, Nov. 3, 1927 (*type*).

Dothidina sphaerospora Chardon spec. nov.

Spots hypophyllous, not exceeding the stromata; stromata dothideaceous, warty, black, coalesscing and aranged in conspicuous, circular clusters 1–3 mm. across; locules globose or slighly irregular through lateral pressure, 300–400 × 250–300 u, asci cylindrical, 8–spored, uniseriate, with the sporiferous part 56–65 × 7 u; spores 1–celled, globose, 8 × 7 u, at first hyaline, provided with a distinct cell wall, later becoming light brown in color, uniseriate; paraphyses profuse.

This fungus is evidently not *Dothidina peribebuyensis* (Speg.) Chardon (Mycologia **13**: 289. 1921) which has spores 14–18 × 6–7 u and reported on various Melastomaceae from South America and Porto Rico, while they are globose 8–7 u, in the Colombian specimen. It is a true dothideaceous form, with erumpent stromata.

On *Clidemia impetiolaris* (Naud.) Cogn.

COLOMBIA: R. A. Toro No. *314,* vicinity of Medellin, Dept. of Antioquia, Jan. 20, 1928 (*type*).

PHYLLACHORACEAE.

Trabutia Mangiferae Chardon spec. nov.

Spots irregular or roughly circular, amphigenuos, brownish brick colored, 12–15 mm. across; stromata hypophyllous black, shiny, irregular, angular, 3–5 mm. across; stroma multiloculate, distinctly situated between the cuticle and the epidermis; locules flat ellipsoidal or angular through lateral pressure, fully immersed in the clack stroma, 240–325 × 120–200 u, asci cylindrical clavate, 8–spored, with the spores biseriate in the main body of the ascus, 62–75 × 15–17 u, spores 1–celled, hyaline, ellipsoidal, 10–12 × 5–6 u; paraphyses present. (Plate II, Fig. 5.)

There is only one dothideaceous fungus reported on this host. *Zimmermanniella trispora* P. Henn. from Buitenzorg, Java. (*Theiss.* & Sydow p. 290). This rare genus is a 3–spored *Bagnisiopsis,* while the species under study is very evidently a new species of *Trabutia*, since the stroma is quite distinctly between the cuticle and the epidermis.

On *Mangifera indica* L.

BRAZIL: U. S. Dept. Agr. No. *61130* (coll. by J. R. Weir), Santa Laura, Madeira River, Amazonas, Aug. 31, 1923 (*type*).

Catacauma costaricense Chardon nom. nov.

Phyllachora Pittieri Speg. Bol. Acad. Nac. Ci. Cordoba **23**: 569. 1919. Not *Ph. Pittieri* Theiss & Syd. Ann. Mycol. **13**: 544. 1915.

It may be interesting to state briefly the nomenclatorial entanglement that has resulted in the adoption of a new name for this species. *Phyllachora Pittieri* was described by Spegazzini in 1919 from material collected by A. Tonduz in Costa Rica in 1897. The specific name is not valid because there is another *Ph. Pittieri* named by Theissen and Sydow in 1915. (Ann. Mycol. **13**: 544).

Prof. Sydow later reported (Ann. Mycol. **24**: 398) two of his collections from Costa Rica as *Pyllachora Pittieri* Speg. These two collections have been examined by the writer, and microscopic sections of the leaves have shown the position of the stroma to be between the epidermis and the mesopyll, thus making this species to fall under the genus *Catacauma*. With the specific name *Pittieri* not valid, and the genus changed from *Phyllachora* to *Catacauma*, the fungus has to be entirely renamed as *Catacauma costaricense* Chardon nom. nov.

In both of Sydow's specimens the spores (11–13 × 6–7 u) are smaller than in Spegazzini's description. This author reports them as 15–16 × 7–9 u.

A third collection by Standley, from Honduras, communicated by Mr. John A. Stevenson, has also been referred here. The spores are also 11–13 × 6–7 but mostly biseriate in the ascus and become somewhat opaque at maturity.

On *Xylosma velutina* Tr. & Planch.

COSTA RICA: H. Sydow No. *92*, La Caja, near San José, Dec. 22, 1924.

On *Xylosma oligendri* Donn. Sm.

COSTA RICA: H. Sydow No. *134*, Cerro de San Isidro, near San Ramón, Feb. 7, 1925.

On *Xylosma* sp.

HONDURAS: U. S. Dept. Agr. No. *55989* (coll. by P. C. Standley), vicinity of Siguatepeque, Feb. 14–27, 1928.

Catacauma Ingae Chardon spec. nov.

Spots approximately circular, yellowish, very small, inconspicuous, 1–1.5 mm. in diameter; stromata epiphyllous, scattered, small, very inconspicuous, 0.5–0.8 mm. across, circular, unilocular, situated between the epidermis and the mesophyll forming a clypeus over the locule, 45–60 u thick, with a portion of compact stromatic tissue in the hypophyll just below the locule but not touching it; locule flat, 300–400 × 80–100 u, asci cylindrical–clavate, 8–spored with the spores inordinate in the ascus, 75–90 × 13–15 u; spores long navicular, hyaline, continuous, 24–26 × 3.5–4 u, provided with several oil drops: paraphyses present.

This species had evidently escaped the attention of the mycologists that have visited Porto Rico due to its minute, inconspicuous stromata. *Ophiodothella Ingae* (P. Henn.) Th. & Syd. reported on *Inga* spec. from São Paulo, Brazil, is evidently different from this species in possessing filiform spores in a parallel arrangement in the ascus.

On *Inga vera* L.

PORTO RICO: C. E. Chardon No. ——* Maricao Insular Forest Reserve, June 9–10, 1928 (*type*).

Catacauma semi-lunata Chardon spec. nov.

Spots not exceeding the stromata but identified with them; stromata black, shiny, occasioning a tar-spot, very conspicuous, epiphyllous, either oval or slightly irregular at first, 3–5 mm. in diameter but often becoming confluent into large irregular, tar-like masses 6–10 mm. across, multilocular in cross section, with 3–5 or even more locules, the stroma located between the epidermis and the mesophyll, the stromatic tissue much more compact and solid black in color above the locules and on their sides; locules globose or ellipsoidal, sometimes angular through lateral pressure, 150–250 × 100–150 u; asci cylindrical clavate, 8–spored, with the spores arranged biseriately in the ascus; spores hyaline, 1–celled, lunnulate, 14–18 × 4–5 u; paraphyses present. (Plate I, Fig. 1).

The shape of the spores of this species, is very characteristic and unique for the group; they are crescent shaped which is very distinctive. This curious spore shape may perhaps serve to justify the erection of a new genus in the Scirrhiineae of the Phyllochoraceae, right next to *Catacauma* and *Catacaumella*, but for the present, the species is included as a *Catacauma* which includes all the forms of the Scirrhiineae having 1–celled, hyaline spores with paraphyses present.

On *Eugenia* sp.

PORTO RICO: C. E. Chardon No. ——* Maricao Insular Forest Reserve, June 9–10, 1928 (*type*).

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* The types of this and the following species were destroyed during the hurricane of September 13, 1928.

Catacauma Weirii Chardon spec. nov.

Spots approximately circular or irregular, conspicuous, pale yellow contrasting with the green tissue of the leaf, epiphyllous but also faintly visible in the hypophyll, 12–20 millimeters across; stromata pale black a, epiphyllous, not shiny, at first approximately circular or slightly angular, 2–3 mm. across, very distinctly between the epidermis and the mesophyll, later coalescing into large, laberynthiform stromata of various shapes, 15 to 20 mm., across; locules many in the stromata, sub-globose, very often flattened, or else angular thru lateral pressure, with most of the black stromatic tissue above or on their sides, very little or none below, 200–400 × 120–160 u; asci cylindrical-clavate, 8–spored, with the spores obliquely uniseriate in the ascus; spores hyaline, 1–celled, smooth, long elliptical with the ends obtuse, 12–13 × 6 u; paraphyses present. (Plate II, Fig. 3).

Ph. tenuis (B. & C.) Sacc. reported from Nicaragua on *Bauhinia* (Theissen & Sydow p. 489) has spores with the same dimensions as this species but being a *Phyllachora* is quite different from *Catacauma* in the position of the stroma within the leaf tissues. The laberynthiform stromata of this form, somewhat suggesting that of *Trabutia conspicua* Chardon (see Mycologia **19**, pl. 27, fig. 4) is very characteristic. Named in honor of its collector, the well known American mycological explorer, Dr. James R. Weir.

On *Bauhinia* sp.

BOLIVIA: U. S. Dept. Agr. No. *61126*, (coll. by J. R. Weir) Riberalta, Rio Beni, Sept. 28, 1923 (*type*).

Robledia Chardon gen. nov. (Phyllachoracearum).

Stromata between the epidermis and the mesophyll; asci cylindrical clavate; spores brown, 2–celled, the upper cell developed, the lower one papillate; paraphyses present. Type species, *Robledia tetraspora*.

In honor of Dr. Emilio Robledo, Colombian physician and botanist, resident in Medellin.

The erection of this new genus in the Scirrhiineae of the Phyllachoraceae is necessary in order to include those forms like the one described below with brown, 2–unlike celled spores (see Theissen and Sydow's keys in Ann. Mycol. **13**: 177). In the genus *Phaedothiopsis* Theiss. & Syd. the spores are brown 2–celled, with the cells alike, while in the new genus *Robledia*, the spores are also brown 2–celled, but the cells are unlike.

Robledia tetraspora Chardon spec. nov.

Spots not exceeding the stromata; stromata epiphyllous, black, not shiny, warty, globose to subglobose, 1–2 mm. across, situated between the epidermis and the mesophyll; locules many in the stroma, elliptical or angular through lateral pressure, 125–180 × 80–120 u, with most of the black stromatic tissue above, with some on the sides and none below; asci cylindrical or cylindrical–clavate, 4–spored, 45–62 × 12–18 u, with the spores uniseriate or biseriate; spores 2–celled, yellowish brown, with the cells unlike, the upper cell long elliptical, 14–20 × 6–7 u, provided with a distinct cell wall, 1 u thick, the lower cell papillate, 2–3 u across; paraphyses present. (Plate I, Fig. 2).

This is a distinct species characterized by the 4–spored asci.

On *Eupatorium tacotanum* Klett.

COLOMBIA: R. A. Toro No. *312*, La Primavera, Dept. of Antioquia, Dec. 25, 1927 (*type*).

Phyllachora Ortonii Chardon spec. nov.

Stromata amphigenous, black, not shiny, 0.8–1.0 mm. long×0.3–0.6 mm. wide, but coalescing to form a long linear row of stromata 4.0 to 8.0 mm. or even more in length, parallel to the main axis of the leaf; fructification simple, with a large globose or elliptical locule, 180–230 × 80–100 u, completely immersed in the mesophyll of the leaf, and surrounded on all sides by the black stroma; asci cylindrical-clavate, 8–spored, with the spores biseriate in the main body of the ascus, 80–92 × 13–18 u; spores hyaline, 1-celled, elliptical with somewhat acute ends, 13–15 × 5–6 u; paraphyses present.

This specimen appears determined in the herbarium as *Phyllachora Andropogonis* Schw., a species which according to Dr. C. R. Orton does not occur in Porto Rico; Dr. Orton is evidently correct since the spore dimensions given for *Ph. Andropogonis* are 16–20 × 6–8 u. In *Ph. infuscans* Winter (Theiss & Sydow, p. 456) reported on *Paspalum* sp. from Brazil, the spores are even larger, 22–27 × 9–11 u. In the opinion of the writer the erection of a new species is amply justified here, which is dedicated to Dr. C. R. Orton, who has given much study to the American grass forms of *Phyllachora*.

On *Paspalum millegrana* Schrad.

PORTO RICO: F. L. Stevens No. *6763*, Naguabo; no month specified, 1913 (*type*).

Phyllachora brevifolia Chardon spec. nov.

Stromata amphigenous, black, not shiny, 0.8 to 1.0 mm. long × 0.5 to 0.8 mm. wide, the longer dimension following the main axis of the leaf, mostly isolated, seldom coalescing; fructification simple, or very rarely 2–loculate, with the locule covered above and below with black stromatic tissue, locule flat with the lower surface straight, the upper distinctly convex, 180–250 × 45–60 u; asci cylindrical-clavate, 8–spored with the spores mostly uniseriate or sometimes partially biseriate, 54–62 × 9–11 u; spores hyaline 1-celled, distinctly lemon shaped with acute ends, 9–11 × 4–5 u; paraphyses present.

This species had been reported by Seaver and Chardon (p. 51), based on determination made by C. R. Orton, as *Phyllachora assimilis* Theiss & Sydow. An examination of a fragment of the type of this species (Butler No. *1250*) which was kindly supplied by Dr. H. Sydow has shown that the Porto Rican material is different from it. In *P. assimilis*, the stromata are always multiloculate, while in our form they are uniloculate or very rarely biloculate. Furthermore, in *Ph. assimilis* the spores are not lemon-shaped with acute ends, but ellipsoidal with blunt ends; the spore measurements are also different. These differences have determined the writer in erecting a new species.

On *Schizachyrium brevifolium* (Sw.) Ness. (*Andropogon brevifolius* Sw.).

PORTO RICO: F. L. Stevens No. *5751* (Cornell University No. *11099*), Río Piedras, Nov. 3, 1913 (*type*); B. López No. *7899*, Experiment Station Grounds, Río Piedras, Aug. 1922.

PHYLLACHORA ERIOCHLOAE Speg., Anal. Mus. Nac. Buenos Aires **19**: 416. 1909.

Seaver and Chardon (Sci. Surv. Porto Rico and Virgin Ids. **8**: 52) based mostly on determinations made by C. R. Orton, have reported the occurrence of this species in Porto Rico, on two hosts: *Paspalum conjugatum* Berg. and *Valota insularis* (L.) Chase. It seems evident, however, that we are dealing with two distinct forms, neither of which agree with the description of Spegazzini's species, which has spores described as "sporae oblique monostichae, apice altero obtuse rotundatae, altero abruptiuscule cuneatoacutatae, 14–15 × 7 u hyalino." None of the material from Port oRico or Santo Domingo properly falls under *P. Eriochloae* Speg.: the one on *Paspalum conjugatum* Berg. is referred here to *Phyllachora paspalicola* P. Henn, while the one on *Valota insularis* (L.) Chase is herein described as a new species, *Phyllachora insularis*.

Toro (Mycologia **19**: 80) also reports *Phyllachora Eriochloae* Speg. from Santo Domingo on the two above-mentioned hosts. After a careful examination of his material, the form on *Valota* insularis (L.) Chase, seems to be identical with the Porto Rican form *Phyllachora insularis* sp. nov., while the one on *Paspalum conjugatum* Berg., is a species of *Telimena*, described in this paper as *Telimena domingensis* sp. nov.

Thus it seems justifiable for the present to exclude *Phyllachora*

Eriochloae Speg. from both Porto Rico and Santo Domingo, thus restricting its range to continental South America.

Phyllachora insularis Chardon spec. nov.

Stromata mostly epiphyllous, but obten hypophyllous, black, not shiny; at first small, punctiform, globose, 0.5 mm. in diameter arranged in linear rows parallel to the main axis of the leaf, later coalescing into large, conspicuous, irregular, black stromata 2–5 mm. long, 1–2 mm. wide, enclosing 3 to 5 or more locules; locules flat ellipsoidal, or angular, thru lateral pressure, 150–240 × 120–150 u, with a black, prominent clypeus on the roof of the locules, which may run along their sides and bottom; asci long-cylindrical, 60–75 × 6–8 u, 8-spored with the spores uniseriate in the ascus; spores hyaline, continuous, ellipsoidal with both ends obtuse, 8–10 × 4–5 u; paraphyses present.

This is evidently not *Phyllachora Eriochloae* Speg. whose spores are reported to measure 14–15 × 7 u. Our material does conform in macroscopic stromatal characters with Mayors No. *158* from Colombia which was first reported by Sydow (Mem. soc. neuch. Sci. nat. **5**: 436) as *Ph. Eriochloae* Speg., and later, by Theissen and Sydow (Ann. Mycol. **13**: 448) as *Ph. Eriochloae* Speg. var. *columbiensis*. The spores in the Colombian specimen, however, measure 10–12 × 4–5 u and the ends are acute, not blunt as in the Porto Rican and Santo Domingan material. These differences warrant the erection of a new species, distinct from the South American form.

On *Valota insularis* (L.) Chase.

Porto Rico: Barceloneta, Whetzel & Olive No. *551*, Feb. 25, 1916, (*type*); along river north of Peñuelas, Chardon No. *1021*, July 28, 1920; Finca Pretoria, Peñuelas, Chardon No. *1047*, July 20, 1920.

Santo Domingo: Santiago Kern & Toro No. *275*, Mar. 21, 1926; Bajabonico, Kern & Toro No. *252*, Mar. 23, 1926; Jaina, Kern & Toro No. *307*, Mar. 30, 1926.

Phyllachora Paspalicola P. Henn. Hedwigia **48**: 106. 1908.

Previously reported by Seaver and Chardon (Sci. Surv. Porto Rico and Virgin Ids. **8**: 52), as *Phyllachora Eriochloae* Speg. The spores of the Porto Rican material are distinctly lemon-shaped, 8–10 × 5–6 u, which evidently do not conform with the spore measurements of the Spegazzinian species.

It seems appropriate to refer it to *Ph. paspalicola* P. Henn. Although the type of this species (from Pará, Brazil) has not been seen, our material conforms very well with Mayor's No. *165*, from Colombia and determined as such by Sydow.

On *Paspalum conjugatum* Berg.

PORTO RICO: College grounds, Mayagüez, Chardon No. *918*, July 15, 1920; Corral Viejo, road to Adjuntas, Chardon No. *904*, Aug. 15, 1920.

Phyllachora Paspali-virgati Chardon spec. nov.

Stromata amphigenous, black, not shiny, 1–2 mm. long, 0.5 to 1 mm. wide, with 2 to 3 locules, entirely immersed in the mesophyll of the leaf, bordered on all sides with black stromatal tissue; locules flat globose or angular thru lateral pressure, 125–200 × 100–125 u; asci cylindrical, 8–spored; spores uniseriate in the ascus, hyaline, continuous, long–elliptical with both ends obtuse, 8–10 × 4–5 u; paraphyses present.

The spores in this species agree in shape and size with those already given for *Phyllachora insularis* sp. nov. but in stromatal characters, the two forms are quite distinct: In *Ph. insularis* the stromata are mostly epiphyllous with scarcely any stromatal tissue under the locule, while in *Ph. Paspali-virgati* the stromata are amphigenous and the locules surrounded on all sides by the black stroma.

On *Paspalum virgatum* L.

PORTO RICO: Along railroad, San Germán, Whetzel and Olive, No. *559* (*type*), Apr. 2, 1916; Poultry Farm, Guaynabo, Whetzel, Kern and Toro, No. *2570*, June 25, 1924.

Phyllachora macorisensis Chardon spec. nov.

Stromata amphigenous, black, not shiny, scattered 0.5 to 1.5 mm. long × 0.3–0.5 mm. wide; fructification simple, more often compound, with 2–3 or rarely 5 loculi; locules elliptical, flattened, or irregular thru lateral pressure, 160–200 × 120–140 u; asci cylindrical-clavate, 75–90 × 8–12 u, 8–spored; spores ellipsoidal, hyaline or faintly pale, 1–celled, 10–11 × 4–5.6 u, uniseriate; paraphyses filiform, longer than the asci.

No *Phyllachora* has been reported to occur on *Stenotaphrum*. This seems to be quite distinct from other known species on Gramineae.

On *Stenotaphrum* sp.

SANTO DOMINGO: San Pedro de Macorís, Kern & Toro, No. *150*, Mar. 10, 1926 (*type*).

Phyllachora Rhynchosporae Chardon spec. nov.

Stromata amphigenous black, not shiny, scattered, 0.5 to 1.5 mm. long × 0.2 × 0.5 mm. wide; fructification simple, or rarely compound, with 2 or at the most 3 loculi; locules elliptical globose, somewhat flattened, seldom irregular, 120–200 × 100–135 u; asci elliptical-clavate, somewhat bulged in the middle, 85–110 × 16–22 u, 8–spored; spores navicular with the ends acute, faintly pale, uniseriate above and below, biseriate in the main body of the ascus, 1–celled, 15–17.5 × 4–4.5 u; paraphyses filiform, longer than the asci.

No *Phyllachora* has been reported on *Rhynchospora*, although several are known to occur on other cyperaceous hosts. The spore characters of this species are very distinct, and entirely justify the erection of a new species.

On *Rhynchospora cyperoides* (Sw.) Mart.

SANTO DOMINGO: Santo Domingo City, Kern & Toro No. *302*, Mar. 27, 1926 (*type*).

Sphaerodothis antioquensis Chardon spec. nov.

Stromata amphigenous, black, shiny, equally visible on both surfaces of the leaf, 1.0–1.5 mm. long to .8–1.0 mm. wide, the longer dimension following the main axis of the leaf, very seldom coalescing; fructification simple, with stromata immersed in the mesophyll of the leaf and the locule entirely covered by black stromata, locule flattened, large, 250–350 × 75–120; asci clavate, 8–spored, 65–78 × 20–23, with the spores inordinate in the ascus; spores elliptical, with blunt ends, 1–celled, distinctly brown in color 16–20 × 10–12 u; paraphyses present.

There being no species of *Sphaerodothis* reported on this host, the fungus is described herein as a new species.

On *Arthrostylidium* sp.

COLOMBIA: R. A. Toro, No. *284*, Santiago, Dept. of Antioquia, No. 13, 1927 (*type*).

Sphaerodothis luquillensis Chardon spec. nov.

Spots not exceeding the stromata; stromata amphigenous, black, shiny, small at first, 0.8–1 mm. long × 0.4–0.7 mm. wide, with the long axis parallel to the main axis of the leaf, later coalescing profusely, forming rows of linear stromata several millimeters long, unilocular in a cross section of the leaf; locule 250–300 × 120–150 u; asci cylindrical-clavate, 8–spored, 84–95 × 7–8 u, with the spores arranged uniseriately; spores at first broad elliptical, hyaline, 1–celled full of oil droplets, 12–14 × 6–6.5 u, later turning light brownish and reducing in size, at full maturity, long elliptical, with acute ends, distinctly brown in color, evanescent, 1–celled, 8–9 × 3–3.5 u; paraphyses profuse.

No species of *Sphaerodothis* appears to occur on Gramineae in Theissen and Sydow. The spore characters of this form are quite distinct. The reduction in the size of the spores as they aproach maturity is interesting and has been clearly followed by the writer.

On *Eriochloa punctata* (L.) Desv.

PORTO RICO: C. E. Chardon & M. F. Barrus No. *3113*, La Catalina coffee farm, Luquillo Mountains, Jan. 21, 1928 (*type*).

Telimena domingensis Chardon spec. nov.

Stromata on both surfaces of the leaf, small, black, not shiny, less than 1 mm. in diameter, mostly uniloculate, seldom biloculate; locules 150–190 × 100–125 u, entirely immersed in the mesophyll and surrounded by a black stroma, at first enclosing numerous 1–septate, fusoid, hyaline stylospores, 21–24 × 2–3 u; asci cylindrical-clavate, 48–56 × 4–5 u, 8–spored with the spores arranged biseriately in the ascus; spores fusoid, 3–septate, hyaline to greenish with both ends acute, 12–14 × 2–3 u; paraphyses present.

Thru an error in determination this was reported by Toro (Mycologia **19**: 80) as *Phyllachora Eriochloae* Speg. *Telimena graminella* Sydow (Fungi, exot. exc. *399*) on *Paspalum* from the Philippines, has much larger spores, 20–25 × 4–4.5 u.

On *Paspalum conjugatum* Berg.

SANTO DOMINGO: San Cristobal, Kern and Toro, No. *156*, Mar. 12, 1926 (*type*).

Ophiodothella floridana Chardon spec. nov.

Spots large, very conspicuous, roughly circular or irregular through coalescence, 8–15 mm. across, amphigenous but more pronounced in the undersurface of the leaf, with a black, not shiny, conspicuous stroma, 5–12 mm. across, in the center of the spot, bordered by a distinct yellowish zone which borders the stroma on all sides; stroma multiloculate, with locules in a row facing the undersurface, immersed in the mesophyll of the leaf, with heavy stroma above, lighter below; locules globose or elliptical, 250–350 × 200–280 u; asci cylindrical-clavate, 8–spored, 80–112 × 11–13 u; spores filiform, 1–celled, hyaline, 56–64 × 4 u; paraphyses present. (Plate II, Fig. 5).

A conspicuously large form, superficially resembling some species of *Catacauma* known on various *Ficus*, but falling in the genus *Ophidothella* v. Hohn, on account of its filiform spores.

On *Ficus* sp.

FLORIDA: U. S. Dept. Agric. No. *60925* (collected by L. H. Mc Cullough) Miami, no date (*type*).

RÍO PIEDRAS, PORTO RICO.

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EXPLANATION OF PLATES I AND II.

Fig. 1. Small branch of *Eugenia* sp. showing tar-spot stromata of *Catacauma semilunata* sp. nov. (nat. size).

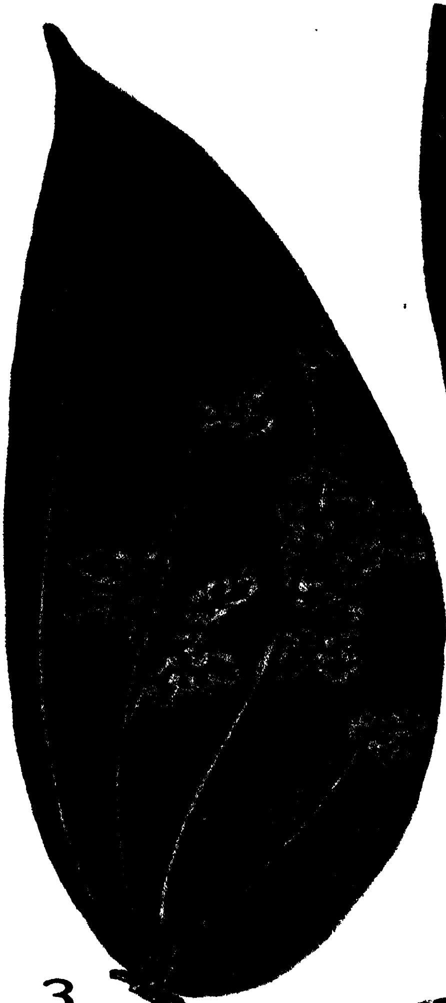
Fig. 2. Small branch and inflorescence of *Eupatorium tacotanum* showing small inconspicuous stromata of *Robledia tetraspora* gen. et sp. nov. (nat. size).

Fig. 3. Leaf of *Bauhinia* sp. showing laberynthiform stromata of *Catacauma Weirii* sp. nov. (nat. size).

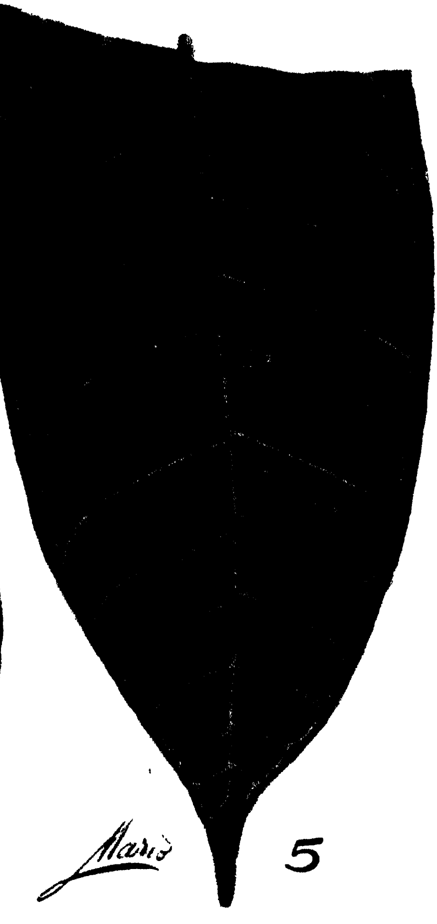
Fig. 4. Leaf of *Ficus* sp. showing conspicuous stromata of *Ophiodothella floridana* sp. nov. (nat. size).

Fig. 5. Leaf of *Mangifera indica* showing tar-spot stromata of *Trabutia Mangiferae* sp. nov. (nat. size).

PLATE II.

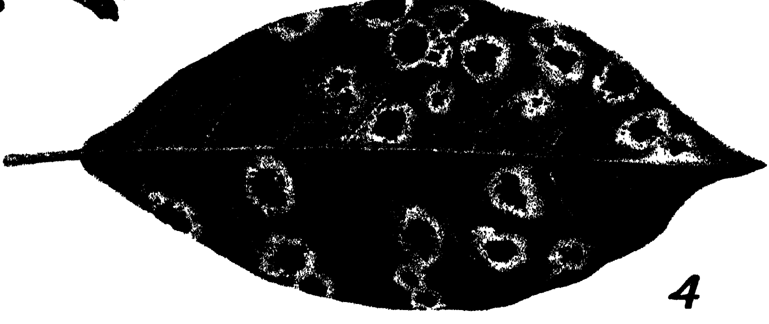


3



Mario

5



4

LIFE HISTORY OF LIGNIERA VASCULARUM (Matz) Cook

(Formerly known as *Plasmodiophora vascularum*).

MELVILLE T. COOK

(WITH PLATES III–VI)

This organism is the cause of a disease of sugar cane in Porto Rico and was described by Matz (**12**) in 1920 under the name of *Plasmodiophora vascularum.* The organism has not been reported from any other part of the world. This paper is a record of studies on the life history of the organism which have resulted in the author transferring it from the genus *Plasmodiophora* to the genus *Ligniera* Maire and Tison.

HISTORY

The organism was first reported by Matz (**12**) in 1920 as the cause of a disease of sugar cane commonly known as "dry top rot". He reports his first discovery on Cavengerie cane at Bayamón in the fall of 1919. In this and a later paper (**13**) he reports the disease on a Porto Rico seedling, Otaheite, Crystalina, Rayada, D–109 and Yellow Caledonia. In the second paper he states—"The disease was found distributed in practically all the principal sugar-cane-growing sections of the Island, on the north coast as well on the irrigated south coast, in isolated areas on the western end, and in the central district around Cayey and Morovis. It was particularly noticeable in fields which showed evident signs of retarded growth and dwarfing especially in ratoon fields".

In his second paper (**13**) Matz states that "From observations made on sugar cane diseases in Porto Rico it is now certain that in so far as reduction of yield is concerned this dry top rot or vascular disease is the most serious of the three or four major diseases of sugar cane existing at present in Porto Rico".

The writer of this paper has found the disease well distributed over the Island and on several varieties but has found but one severe outbreak which was in the vicinity of Canóvanas and involved about 300 acres of D–109 which was growing on low wet land. The other outbreaks observed by the writer were in some cases severe but over small areas and always in wet land. Numerous small outbreaks were observed, usually in the coastal plains. Several infected stools were found in a small poorly drained field near Cayey which is about 1,300 feet above sea level. The controlling factors appear to be susceptibility of varieties and amount of moisture.

SYMPTOMS

The disease gets its name "dry top rot" from the dying and drying of the tops but it should be remembered that a dying of the tops may be due to borers and to other causes. This symptom is proceeded by a reduction of the leaves and frequently by a rolling and wilting of the leaves. In severe cases a part or all of the canes in a stool may be dwarfed and die from the tops down. These dead tops are frequently attacked by saprophytes which cause a decay. It is not unusual to find many canes of various ages, especially those under five feet in height, dead from this disease. These dead canes may lose all their leaves and are frequently attacked by the rind fungus (*Melanconium sacchari*) which may mislead the observer as to the true cause of the dying. When infected canes are cut across at the base, some of the fibro-vascular bundles show a lemon or orange yellow color. When the sections of this tissue are examined under the microscope the tracheary tubes of these bundles will be found to be filled with a plasmodium or large spores. It is very evident that this plugging of these water passages will be disastrous to the growth of the cane. However, weak or dead canes may show only a few infected bundles and it is difficult to understand just how such slight infection can kill the canes. The organism can also be found in the roots. After a time the organism may disappear and the bundles show a pronounced red color. Although some of these external symptoms may be common to other diseases of the sugar cane, the presence of the spores in the tracheary tissues is so characteristic that the disease cannot be confused with any other known disease of sugar cane.

Matz described (**12**) the organism as follows: "The spores in their advanced stage in the interior of the vessels of fibro-vascular bundles are spherical with smooth, somewhat thick hyaline walls, evenly granulated or sometimes coarsely granulated in the interior, orange, yellow, sometimes slightly brown in color, measuring .014–.016 millimeters in diameter. Spores are embedded in a yellowish hyaline, at length hard matrix. Plasma is composed of a mass of granular cytoplasm, later developing into individuals composed of clear cytoplasmic variable bodies having a dense, darker, granular center".

The writer of this paper was induced to take up the study of this disease and the organism causing it, (1) because it appeared that the disease was likely to prove of major importance and (2) because it appeared to be desirable to make more extensive comparisons of the organism with other genera and species of the Family-Plasmodiophoraceae.

METHODS

The methods of work were as follows: (1) Field observations were made to determine symptoms, severity and resistant varieties. (2) Free hand sections of fresh material were made and studied in the laboratory. Sections were mounted in sterilized water and kept under observation for the purpose of observing germination of spores. Blocks of fresh material were kept in sterilized water for the same purpose. (3) Material was killed and fixed by several methods, embedded in paraffin, sectioned and stained by several methods. Flemming's weaker fluid and Haidenhain's iron-alum haematoxylin stain were most satisfactory.

LIFE HISTORY

The life history resembles that of a number of other species of the family *Plasmodiophoraceae*. The plasmodium is produced in abundance and frequently fills the tracheary tubes (Fig. 1). It is very evident that this is the product of germinating spores; and spores that have failed to germinate are frequently found in this plasmodial mass (Fig. 1). The plasmodium may be uniform in character (Fig. 1) or it may vary in density (Fig. 2). Matz states that it occurs in the annular and spiral tracheids and pitted vessels in the fibro-vascular bundles in the lower nodes. In some cases the writer of this paper found the organism in the tracheary tubes only, while in other cases it was also found in the surrounding cells of the fibro-vascular bundle and rarely in the parenchyma cells (Figs. 3 and 9). Both the plasmodium and the spores were most abundant in the basal part of the plant but were sometimes found at a considerable distance above ground. The older or more mature stages are always below the younger stages, indicating that the organism was moving upward into the growing plant. The stages of development in these adjoining cells are not always the same; some may shown plasmodia while others show spores in various stages of development (Figs. 3 and 9). Nuclei could not be seen in any of the preparations until the spores began to form (Figs. 4 and 5) and sometimes the nuclei were not visible even when spore formation was well advanced (Figs. 3 and 6). In some few cases the nuclei were very prominent at an early stage of spore development (Fig. 8). The first stages in spore formation were very indistinct (Figs. 4 and 5), but later became more definite (Fig. 6). In some cases the entire mass of plasmodium appeared to have been consumed in spore formation (Figs. 6 and 7), while in other cases only a part had been used (Figs. 3, 8 and 9), the remainder forming a matrix in which the spores were embedded.

The cell wall appears as a single membrane early in the spore formation (Figs. 8, 9, 10, 11 and 12), but thickens with age (Fig. 18). In the early stage of spore development a spore appears as a uniform granular mass, surrounded by a delicate membrane and with a single nucleus which stains deep and uniform (Figs. 9, 10, 11 and 12). In some few cases these developing spores show bodies which turn black under the action of Flemming's fluid (Fig. 13) and resemble nuclei. They are probably fat bodies. These spores vary greatly in size (Figs. 14, 15, 16 and 17), but the writer was unable to determine just how much growth was made after the formation of the cell wall. In its further development numerous vacuoles are formed in the protoplasm, the nucleus becómes large with a well defined nucleolus and the cell wall becomes very thick (Figs. 15, 16, 17 and 18). The cell wall is so thick that the killing fluids do not penetrate readily. Therefore, it is difficult to study the contents of the mature spores but the protoplasm may be dense or vacuolar and fat bodies may be few or abundant. The spores are smooth and when not subject to pressure are spherical in form (Fig. 18). When mature these spores usually fill the large tracheary tubes (Fig. 19), but in some cases excess plasmodium is visible. In small tubes the spores may lie in a single row (Fig. 16), while in large tubes they form a mass (Fig. 19). When mature the spores in any individual tracheary tube are usually quite uniform and of a maximum size, but some variations may occur (Fig. 19). They are usually lemon or orange yellow or slightly brownish in color when old.

The germination of these spores and their behavior after germination is rather difficult to follow. Matz (12) says: "At first an attempt was made to germinate the spores of the organism in water, in sugar water, in cane juice, in fermented but sterilized cane juice and in several agars but no germination was observed to have taken place. Spores were kept in moist cells for over six months and no germination was observed to have taken place. Portions of cane stalks which contained bundles filled with the organism in its several stages were cut and placed in moist chambers together with healthy seed pieces of Rayada cane, and after five months it was found that the roots of the Rayada cane contained many of the spherical spores of the organism. Apparently a transfer of the organism from its original seat into the healthy cane had taken place. Inoculations with bits of infested bundles into six healthy canes were made in the basal regions of the latter. The six cane stools thus inoculated showed marked stunting in contrast with other uninoculated canes growing alongside of the former''.

The writer of this paper found this phase of the problem quite difficult and is not sure that all the observations are absolutely correct. When apparently mature spores were squeezed out into drops of sterilized water on clean slides and kept in moist chambers, short germ tubes were produced on a large percentage of them (Fig. 20). In many cases the points of these tubes were open and the contents gone but the writer never succeeded in seeing one of them open and the contents emerge. A few spores with germ tubes were found in the tracheary tubes. Free swimming zoospores were observed and, although it was difficult to make sure that sterilization processes for the destruction of other organisms were all that was to be desired, it is reasonable to suppose that they came from the spores. The movement of these zoospores was very rapid and it was difficult to make a satisfactory study, but they appeared to be uni-ciliate. This opinion appears to have been confirmed by the findings of two uniciliate zoospores (Fig. 21) in the tracheary tubes in prepared sections. Neither union nor division of these free swimming zoospores were observed but numerous cells of various sizes, that appeared to have possessed euglenoid and amoeboid characters were observed in the tracheary tubes in the prepared sections (Figs. 22 and 23). Therefore, it is reasonable to assume that the flagellate zoospores become euglenoid, then amoeboid and that they eventually unite to form the plasmodium, thus completing the life cycle. Actively growing cane would undoubtedly furnish abundant food for a rapid growth of the organism. However, other stages, such as unions and divisions may have occurred and not been observed by the author.

Judging from the preceeding studies it appears probable that spores may germinate in the tracheary tube and unite to form a plasmodium and that the organism travels from the older to the newer parts of the plant either as zoospores or as a plasmodium and may complete the life history without escaping from the host. Since the new shoots of a diseased stool are very generally infected, it is also reasonable to assume that the zoospores or the plasmodium may travel downward and then out into the new shoots in the same manner that they may travel upward into a growing shoot.

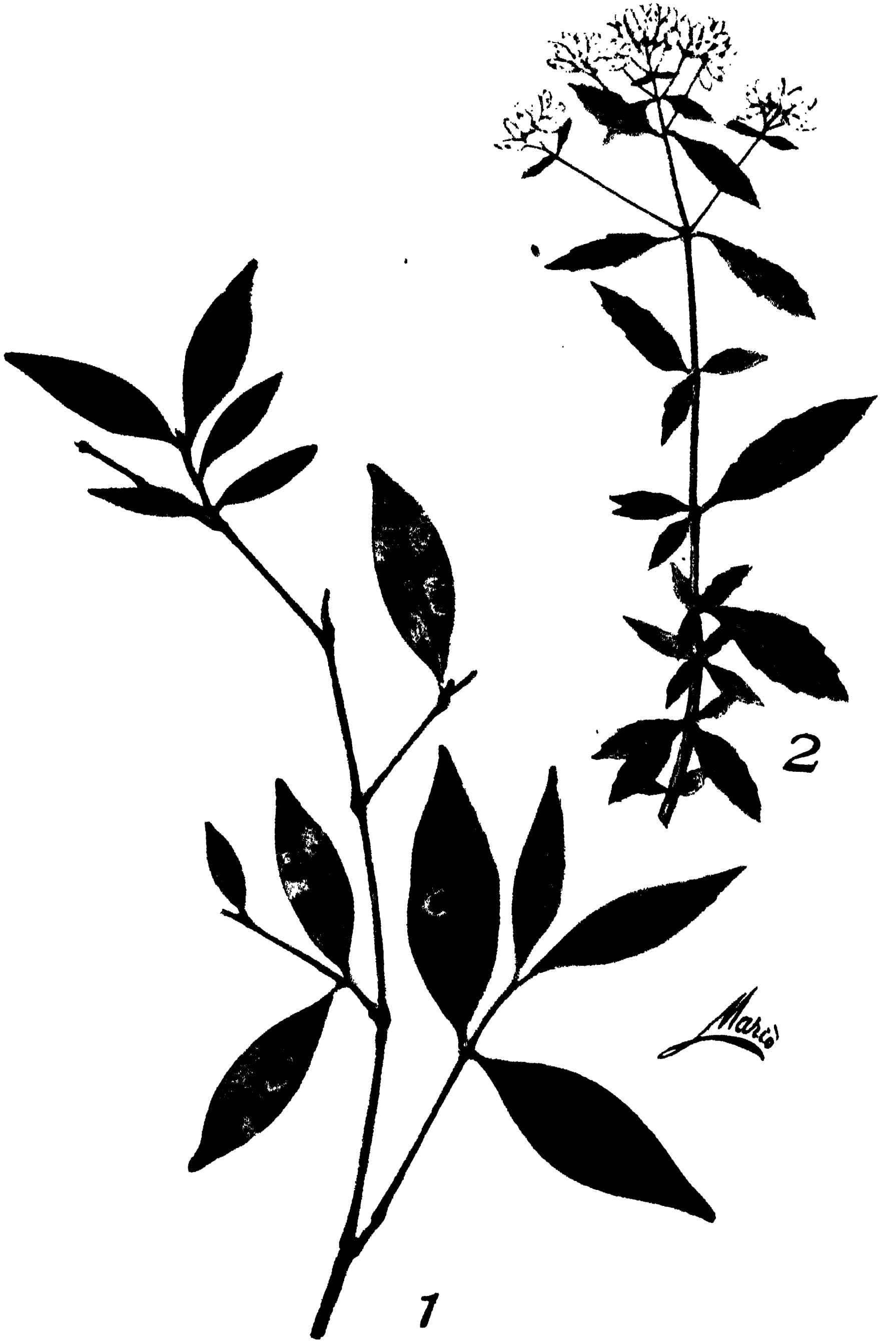
EFFECT ON TISSUES OF THE HOST

There was no cell destruction or hypertrophy of the host tissues as in the case of other species of the genus *Plasmodiophora* and this is the character on which Maire and Tison (**10, 11**) erected the genus *Ligniera.* The hypertrophies of the tissues of the hosts which are induced by some species of *Plasmodiophora* may be explained by the fact that these parasites attack active meristomatic tissues, while this organism attacks the tracheary tissues which have passed the meristomatic stage. Vascular tissues occur in potato warts (*Chrysophlyctis endobiotica* Schild) (**1, 7, 15**) but the warts are apparently the result of a stimulation of meristomatic tissues of the host which have resulted in the formation of both parenchyma and vascular cells. None of the papers which have come to the authors attention indicate any stimulation of vascular tissues. This interpretation is in harmony with studies by the author on plant galls caused by insects and other abnormal plant growths. The infested fibro-vascular bundles eventually become red, but this reddening which is quite common in the lower parts of canes is not necessarily an indication of disease.

TRANSMISSION

The method of transmission of this organism from plant to plant and from place to place has not been thoroughly studied. It appears that the organism can complete its entire life cycle repeatedly in the fibro-vascular bundles of the growing cane, gradually working from the base upward, so long as it does not kill the individual cane in which it is living. It is also evident that slightly infected canes will have a better chance of surviving than severely infected canes. Slightly infected canes which do not show the symptoms of the disease are very likely to be used for seed and become carriers of the organism. There is abundant evidence to show that this is the case. In the 300 acres of severely infected D–109 to which the writer has referred (page 19) the source of the disease was traced with a reasonable degree of certainty to a field growing on a higher elevation, from which the seed cuttings were obtained and in which the symptoms were few and insignificant, but in which slightly infected canes were found without difficulty. The difference in severity of the disease in the parent and daughter fields was no doubt due to the fact that the differences in elevation and drainage in the two fields made the conditions for the growth of the organism more favorable in the daughter than in the parent field.

PLATE I.



The formation of free swimming zoospores and the fact that the disease is most severe in wet soils are reasons for believing that the organism can travel from plant to plant. The experimental work on this phase of the problem is insufficient to justify any definite statements at this time (see page 23). However, it is well known that the zoospores of *Plasmodiophora brassicae* (**4**) and some species of *Ligniera* (**10, 11, 16, 17, 18**) gain entrance to healthy plants through the roots. There is some difference of opinion as to whether this entrance is directly into the root or first into the root hairs and thence into the roots, but the evidence indicates that it is through the root hairs. This organism is known to exist in the roots of the sugar cane but its method of entrance has not been studied. Chupp's (**4**) studies on *P. brassicae* indicate that the zoospores do not travel far in the soil. However, organisms of this kind may be carried on farm implements or in drainage or irrigation water for a considerable distance. This phase of the problem should be studied.

COMPARISON WITH RLATED ORGANISMS

The organism was originally placed by Matz in the genus *Plasmodiophora* but it differs from other species of this genus in that it does not produce hypertrophy of the host tissues. According to the present classification it belongs in the genus *Ligniera* which was formed by Maire and Tison (**10, 11**) to include those species of *Plasmodiophoraceae* which produce little or no hypertrophy of the host tissues. It is interesting to note that this classification is based primarily on the reaction of the host to the parasite and not on morphological characters or life history of the parasite. However, this classification has been recognized by some of the leading students of this order, who are referred to in this paper. Therefore, it is desirable to compare this organism with recogized species in these and other genera of the *Plasmodiophoraceae*, especially belonging to the genera *Plasmodiophora* and *Ligniera*.

One very marked difference between *Plasmodiophora brassicae* and *Ligniera* (*Plasmodiophora*) *vascularum* is that the former attacks the parenchyma tissues while the latter lives primarily in the tracheary tissues. The plasmodium of *P. brassicae* produces resting spores which germinate in a very similar manner to what we find in *L. vascularum*. Chupp (**4**) was able to observe the germination of the spores of *P. brassicae* and states that the actual germination is proceeded by a swelling of the resting spore which is not true in the case of *L. vascularum*. The zoospore of *P. brassicae* was uniflagellate and pyriform as in *L. vascularum*. However, he did not observe the various amoeboid forms recorded by Woronin (**20**) and which the writer believes to be characteristic of *L. vascularum*. Both Lutman (**9**) and Chupp (**4**) have demonstrated that the zoospores of *P. brassicae* enter new plants through the root hairs and Chupp figures an amoeba in a swollen root hair. This has not been worked out for *L. vascularum*. Chupp's experiments indicate that the zoospores of *P. brassicae* travel very short distances in undisturbed soils.

In 1911 Maire and Tison (**10, 11**) erected the new genus *Ligniera* for two new species, *L. verrucosa* and *L. radicalis*, which they described. To this new genus they transferred *Sorosphaera Junci* Schwartz (**16**). In 1912 Winge (**19**) reviewed the order *Plasmodiophorales* and placed in the genus *Ligniera* four of his own species which he had previously placed in the genus *Sorosphaera*. In 1914 Schwartz (**17**) recognized the validity of the genus *Ligniera* and described three new species. In 1925 Fron and Gaillat (**6**) described *Ligniera pilorus* on *Poa annua* which they separated from the closely related *Ligniera radicalis* because it produced an enlargement of the root hairs. Schwartz was unable to germinate the spores but Maire and Tison found zoospore formation in *Ligniera radicalis*. Fron and Gaillat also found zoospores. It is very generally believed that the zoospores of the species of this genus gain entrance to the host through the root hairs but the evidence is by no means complete. Cook (**2**) says "When the amoeba is lying in a root hair a swelling is sometimes noticed, though infected root hairs showing no hypertrophy are more common". In 1925 Fron and Gaillat (**6**) separated *Ligniera pilorum* from *Ligniera radicalis* because it induces hypertrophy in the root hairs of the host. However, there is no record of species of the genus *Ligniera* causing hypertrophy in the roots.

The preceding studies indicate that this organism should be transferred to the genus *Ligniera*. The writer therefore proposes the following transfer and revised description:

Ligniera vascularum. (Matz) comb. nov.

Plasmodiophora vascularum Matz, Jour. Dept. Agr. P. R. **4**: 45. 1920.

A yellowish, granular, plasmodium, resting spores or zoospores inhabiting the tracheary tubes and occasionally surrounding cells of sugar cane. The resting spores usually granular, orange, yellowish or slightly brownish in color with thick hyaline walls and measuring about .014–.016 millimeters in diameter. Zoospores pyriform and uniflagelate, becoming euglenoid and amoeboid.

CONTROL

At this time the disease appears to be of minor importance but its presence on the Island is a menace to susceptible varieties especially when grown on wet lands and it may at any time become an important disease on new or introduced varieties. Therefore it is inadvisable to use seed from fields in which the disease is known to occur. Slightly infected seed cuttings may become carriers of the organism from field to field or to distant localities.

SUMMARY

1. The organism previously known as *Plasmodiophora vascularum* Matz is transferred to the genus *Ligniera* Maire and Tison.
2. This organism lives primary in the tracheary tissues of the sugar cane but accasionally spreads to surrounding tissues. It does not cause hypertrophy of the host tissues.
3. It is the cause of a disease of sugar cane known locally as "dry top rot".
4. It is known only in Porto Rico and only in cane.
5. The life history is very similar to that of *Plasmodiophora brassicae* Wor. and to several species which have been placed in the genus *Ligniera* by Maire and Tison, Fron and Gaillat, Guyot, Schwartz and Winge.

The writer wishes to express his thanks to Commissioner Carlos E. Chardon, Director F. Fernández García, Mr. A. R. Cochran of Central Canóvanas and others for assistance in making these studies. Thanks are also due to Dr. R. Ciferri of the Estación Nacional Agronómica, Moca, S. D., for suggestions and bibliographic assistance. Also to Dr. J. H. Barnhart of the New York Botanical Garden for assistance in examining the literature.

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FIGURES

PLATE III

Fig. 1.—Plasmodium in tracheary tube. Also one resting spore which did not germinate.

Fig. 2.—Cross section of tracheary tube showing plasmodium.

Fig. 3.—Cross section of part of fibro-vascular bundle showing plasmodium in tracheary tube and some surrounding cells. Also early stage of spore formation.

Figs. 4 and 5.—Plasmodium showing early stage of spore formation. Note the nuclei.

PLATE IV

Fig. 6.—Early stage of spore formation and one resting spore of preceding generation which has not germinated.

Fig. 7.—Tracheary tube showing slightly advanced stage in spore formation. Note the nuclei.

Fig. 8.—Early stage in spore formation. Note the nuclei and delicate cell wall.

Fig. 9.—Cross section of part of fibro-vascular bundle, showing spore formation in tracheary tube and plasmodium in surrounding cells.

PLATE V

Fig. 10.—Early Stage in spore formation and one resting spore from same tube which has not germinated.

Fig. 11.—Group of forming spores.

Fig. 12.—Group of forming spores in tracheary tube.

Fig. 13.—Young spores showing black spots which are nuclei and fat bodies.

Fig. 14.—Forming spores of various sizes.

Fig. 15.—Spores in advanced stages showing nuclei and vacuoles.

Fig. 16.—Part of small tracheary tube with single row of spores. Slightly shrunken.

Fig. 17.—Oblique section of tracheary tube showing immature spores of several sizes.

PLATE VI

Fig. 18.—Two mature spores.

Fig. 19.—Diagramatic drawing of spores in a tracheary tube.

Fig. 20.—Two spores with germ tubes.

Fig. 21.—Flagellate cells.

Fig. 22.—Euglenoid cells.

Fig. 23.—Amoeboid cells.

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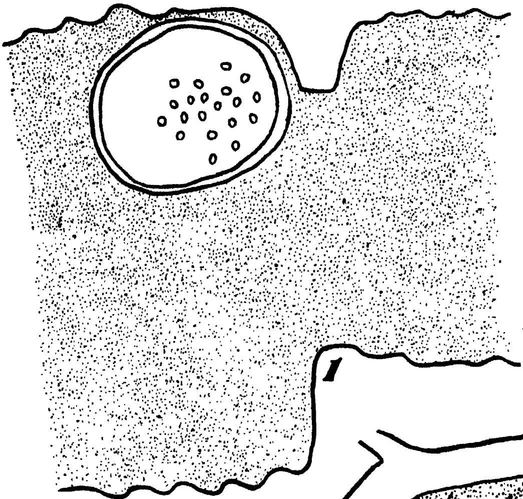

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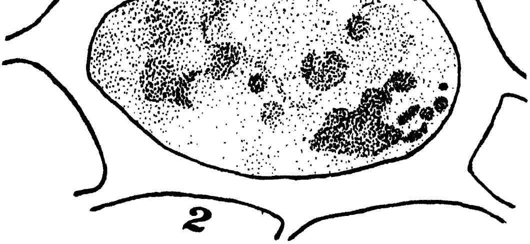

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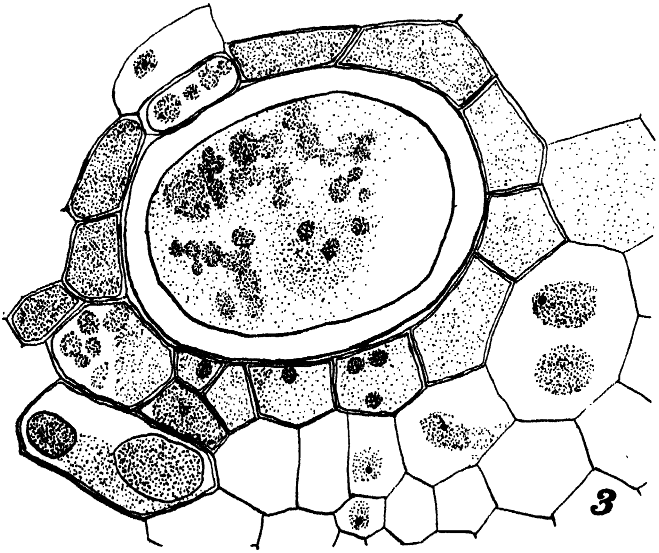

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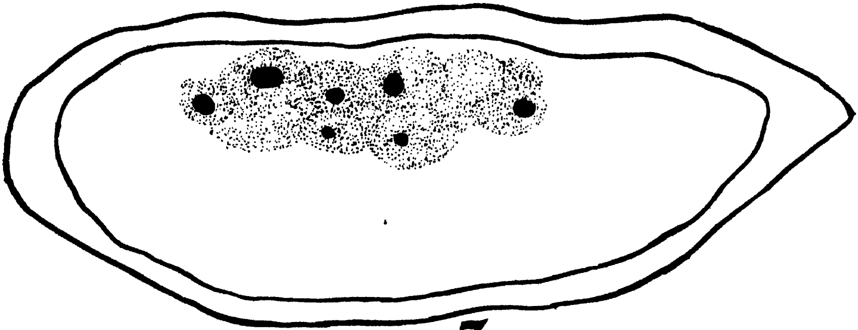
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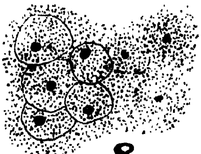
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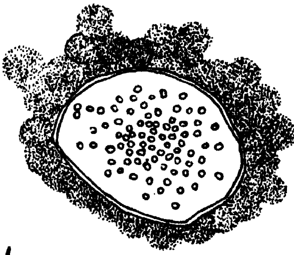
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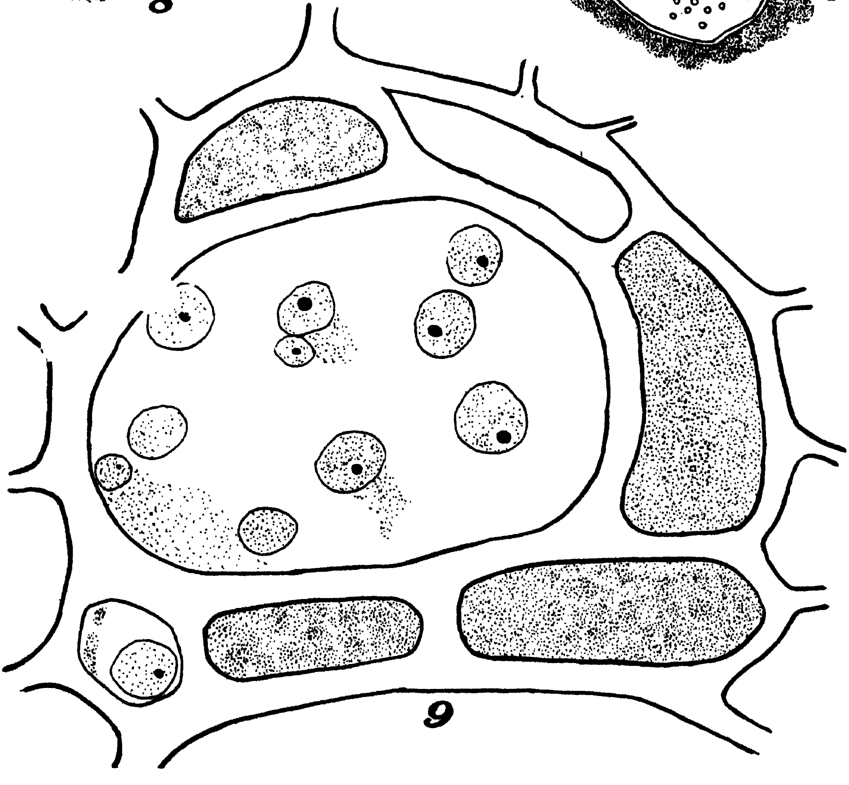
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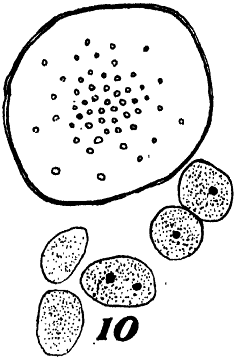
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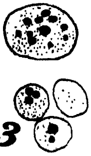
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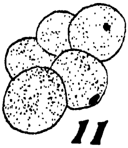
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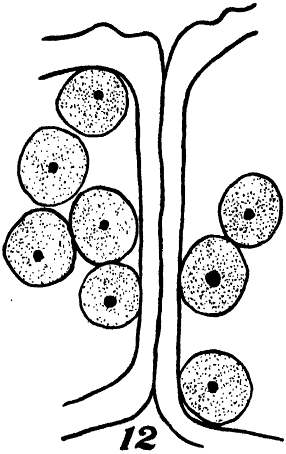
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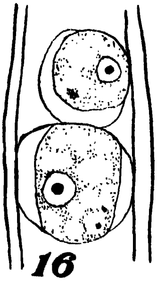
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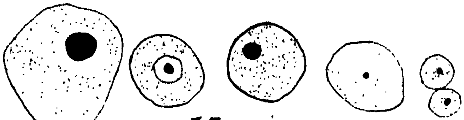
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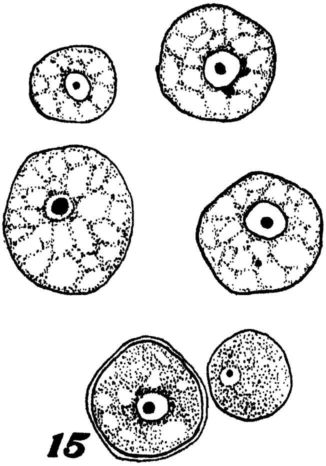
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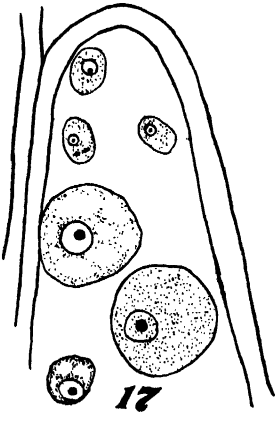
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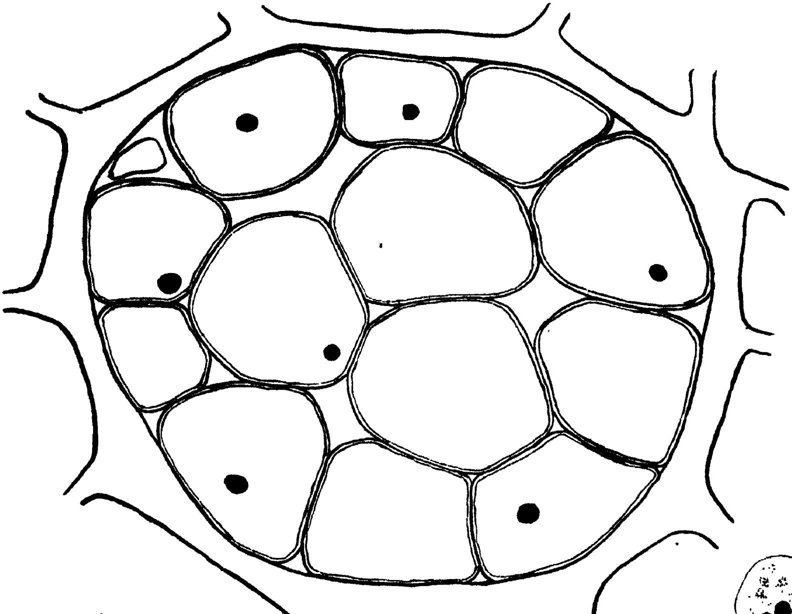
PLATE VI.



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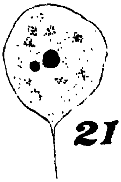

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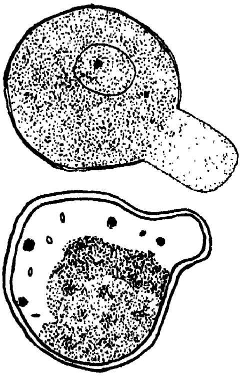

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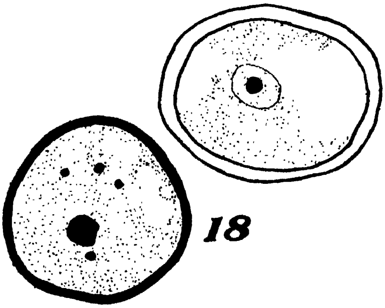

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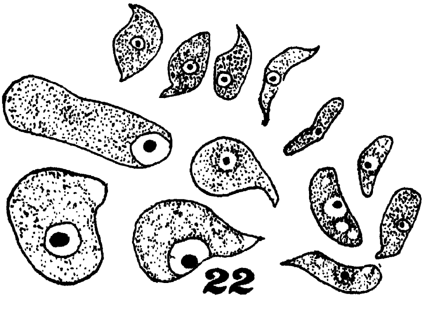

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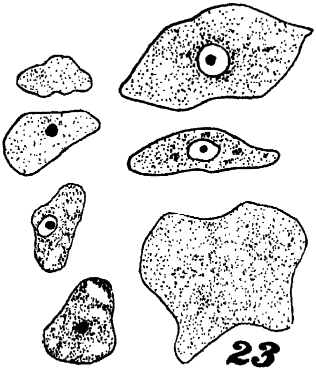

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MELVILLE T. COOK, Editor.

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ACROSTALAGMUS APHIDUM OUD. AND APHID CONTROL

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THE EGGPLANT BLIGHT AND FRUIT ROT IN PORTO RICO

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The two major diseases of the eggplant in Porto Rico are the bacterial wilt and the Phomopsis blight. They are probably of about the same seriousness on this Island. Eggplant growing is probably on the increase. The Phomopsis disease is spreading over the various sections where the host plant is grown. Studies have been carried out with this malady during the last three years. It is the scope of this paper to present our knowledge of the disease up to the present time.

PLANTS AFFECTED

The eggplant (*Solanum melongena* L.) appears to be the only known host of *Phomopsis vexans* (Sacc. & Cyd.) Harter.

VARIETAL SUSCEPTIBILITY

The information in the literature is rather insufficient on the question of susceptibility of eggplant varieties to the Phomopsis blight. Halsted (**9**) in discussing experiments on the control of the disease lists four varieties, namely, Early Long Purple, New York Improved, Improved New York Spineless and Black Pekin. He does not cover the question of the relative susceptibility of those varieties. Figures are given in that paper on sprayed and non-sprayed plots, but they cannot be used in figuring the percentages of diseased fruit because of the small numbers. Bruner (**1**) reports the Florida High Bush and the Excelsior as showing considerable resistance to the Phomopsis blight in Cuba. He almost gives the former as the more resistant of the two. Stevenson and Rose (**24**) reported 43 per cent of dead or dying fruit in a count of 322 plants in Porto Rico. Although they mention in the report that the Improved Purple Thornless and the Florida High Bush were planted, they fail to state whether all the count was from only one or from both varieties. If both were included then the number of plants of each variety is wanting. Edgerton and Moreland (4), however, found the Florida High Bush a very resistant variety as compared to the Black Beauty and the Manmoth Purple. Under conditions in which the latter two types fail the Florida High Bush "results in greater yields and a longer picking season". More recently Weber (26) has reported the native wild eggplant of Florida as immune and further states that selections from crosses between the commercial and the wild plants exhibited resistant qualities.

The disease having been found quite widespred in 1926, tests were conducted in 1927 and 1928 to determine the degree of susceptibility of some of the eggplant varieties in Porto Rico. The following commercial varieties were used in these tests: Black Beauty, New York Spineless, Excelsior, Florida High Bush, New Orleans Market, Large Round Purple. Some Porto Rican varieties not suitable for export were also planted in the experiment: "Fajardo", a plant bearing long, green gourdlike fruits. This is a very vigorous and prolific plant. The "Pompadour", a strong plant with long-ovate fruits of a white color with purple stripes. The "University", a plant bearing round pink fruits. The "Camuy", a prolific plant bearing small, cylindrical, light purple fruits. A plant with round green fruits was discovered in a population of New York Spineless plants and propagated. It has been tentatively referred to as *"Green"*. All the varieties given above were planted in rows of 80 plants each, three rows of each variety. Observations of the precedings season showed the land to be infested with the pathogen. The results appear in Table I.

TABLE I

SHOWS RELATIVE AMOUNT OF THE DISEASE ON DIFFERENT VARIETIES

Row	Variety	Plants		
		Sound	Diseased	Per cent Diseased
1, 12, 23	Black Beauty	90	150	62.50
2, 13, 24	New York Spineless	84	156	65.00
3, 14, 25	Excelsior	71	169	70.42
4, 15, 26	Florida High Bush	93	147	61.25
5, 16, 27	New Orleans Market	73	167	69.58
6, 17, 28	Large Round Purple	91	149	62.08
7, 18, 29	"Fajardo"	102	138	57.50
8, 19, 30	"Camuy"	94	146	60.83
9, 20, 31	"University"	70	170	70.83
10, 21, 32	"Pompadour"	128	112	46.66
11, 22, 33	"Green"	63	177	75.41
Total all varieties		959	1,681	63.67

It was thought at first that counts of diseased and non-infected fruit would be of interest. It was soon found that such counts would not allow of a fair comparison for the reason that a large number of the infected plants died before any fruits were formed. Hence, in recording the number of fruits a large item would naturally be overlooked, which if it were not for the premature death of the plants would appear as diseased fruits. The only other means of estimating the percentage of infection in the various rows was by counts of the plants which bore fruit with disease spots or which had large cankers on the stems, those that had been girdled near the surface of the soil and were eventually killed and even those completely blighted before the production of blossoms. All these were included under "diseased." The plants considered as sound were those which bore only sound fruits and did not show any cankers on the stems or petioles, whether they had any small spots on the leaves or not. It must be observed that a large number of these "sound" plants had one or several leaves with small Phomopsis spots. This arbitrary classification was made because it is known that plants with these symptoms usually bear normal sound fruit.

An examination of the table shows that infection varies from 46.66 per cent for the variety named "Pompadour" to 75.41 per cent for that listed as "*Green*". Out of the eleven varieties nine showed more than 60 per cent diseased individuals. The differences among these nine varieties do not appear to be sufficient to class any of them as more resistant than the other. The difference between "Pompadour"—46.66 per cent infection and "Camuy"—60.83 per cent—, for instance, would appear to be significant and one might be tempted to regard the former as more resistant than the latter. In the writer's opinion, in this particular disease, the number of diseased plants fluctuates so much even within one variety that those differences should not be given much weight. To throw more light on this point figures are presented in Table II of diseased and healthy plants in a planting of the Black Beauty variety. Notes were taken in Cayey, Porto Rico, during the month of December, 1927. The plants were bearing and the same system was followed in the classification of the healthy and diseased plants as was observed in Table I.

TABLE II

Row	Plants			
	Sound	Diseased	Total	Percentage diseased
1	23	48	71	67.61
2	29	42	71	59.15
3	27	50	77	64.94
4	36	42	78	53.85
5	41	42	83	50.60
6	37	42	79	53.16
7	37	45	82	54.88
8	38	37	75	49.33
9	43	52	95	54.74
10	43	48	91	52.75
11	41	38	79	48.10
12	53	35	88	39.77
13	51	45	96	46.88
14	48	40	88	45.45
15	53	57	110	51.82
16	41	45	86	52.33
17	38	42	80	52.50
18	59	34	93	36.56
19	47	47	94	50.00
20	59	41	100	41.00
21	53	43	96	44.79
22	60	36	96	37.50
23	49	48	97	49.48
24	42	57	99	57.58
25	50	46	96	47.92
Totals	1,098	1,102	2,200	50.01

A glance at the table will show that there are all kinds of variations in the percentage of diseased plants in the different rows. The lowest figure was 36.56 per cent in row No. 18; and rows No. 22 and No. 12 showed 37.50 per cent and 39.77 per cent of diseased plants respectively. On the other hand in rows No. 1 and No. 3 the diseased plants made 67.61 per cent and 64.94 per cent of the population respectively. The deviations from the average for the variety in this case are worthy of examination.

Should we attach much weight to those differences occurring within the same variety, in the same fields, all plants the same age, etc.? If we do not, and that would be the logical consequence, then should we establish any difference between this case and that of a field where many varieties are grown? In our opinion we should not. Therefore, we are regarding all the varieties of eggplant tested in Porto Rico as more or less equally susceptible to the Phomopsis blight.

It is of interest that color of fruit or of plant has no bearing on resistance. The white variety "Pompadour" is not so much less susceptible than the "Fajardo", a green-fruited variety. The variety "Green", of green plant and fruit color, is almost as susceptible as the "University" variety—pink fruit—or the black purple fruited "Excelsior". (See Table I).

THE DISEASE

NAMES

Various names have been applied to the disease. "Leaf-blight", "fruit-rot", "leaf-spot", "stem-blight", "foot-rot", "eggplant-blight", and "seedling stem-blight", all appear in the literature. In Cuba (**3**) two names have been given to a disease on leaves—*"mancha de la hoja"* (leaf-spot) and on stems—*"enfermedad del tallo"* (stem disease). These are in all probability the same disease. In Porto Rico we know it as "lunares de la hoja y tallo" and "podredumbre de la fruta".

HISTORY AND RANGE

The disease has probably been known since 1881 when Spegazzini described a new disease of eggplant which is probably the same as that under discussion here. There exists a doubt as to whether that disease is different from the Phomopsis blight. In New Jersey, Continental United States, Halsted (**6**) was the first to study the malady in 1890. Rolfs (**14**) reported it from Florida in 1893. Subsequently it has been reported from other States. It occurs in Italy and in Cuba and probably in all countries where the eggplant is grown. The first report from Porto Rico seems to be that by Stevenson and Rose (**24**). The fact that the disease has been found on new lands where vegetables had never been grown before suggests that it is endemic here.

IMPORTANCE

Vegetable growing in Porto Rico has been shown to be profitable during the season when early shipments can be made to the New York Market. It is to be expected that experienced growers may start a systematic development of this industry here. Since the eggplant is easily grown and handled it will naturally be one of the few vegetable crops to supply the demand. This plant also forms a part of the small patches of vegetables which are grown for the local market. A disease which usually brings about a loss of more than 50 per cent of the crop is certainly a serious menace and should have a more careful attention on the part of the growers.

MORPHOLOGIC SYMPTOMS

For convenience, the symptoms of the blight are given on large plants (transplants in the field) first and for these on leaves, stems and flowers and fruits.

The symptoms on the stem appear as lens-shaped, eye-shaped spots, regular in outline or long irregular cankers. On these the fruiting bodies of the fungus soon appear giving the surfaces of the spots a black-dotted appearance. These spots are first greenish or brownish, soon grayish to white except for the black fruiting bodies scattered throughout. The spots may appear in any location on the stem or branches. In cases of heavy infestations these occur at the crotches of the branches and stems. The seriousness of the spots at this location will be realized when one considers the effect of winds. The slightest breeze will break the branches at this point. When the spots arise farther up on the branches then the weight of the fruit will eventually cause the breaking of the branches. In heavily infested fields or when seedlings from diseased beds are used the pathogene gives rise to serious cankers at or near the surface of the ground. A large number of the plants will die before the first flower bud is out, but in some of them the effects of infection are masked even until the first fruit is picked. In these cases the main stem of the plant breaks at the place of infection where callous formation has proceeded. The terms "tip over" and "foot-rot" have been applied to this condition. Another effect of stem cankers is the girdling of the growing terminal bud in young plants which are beginning to blossom.

On the leaves the disease is more severe on the young transplants when the photosynthetic apparatus is so much needed. During rainy weather the spots appear as small circular to irregular areas between the veins. The color of these necrotic areas is a paler green than that of the blade of the leaf. Soon large irregular spots result. They coalesce, in many cases covering more than three-fourths of the entire blade. In some cases the growth of the fungus seems to become arrested, when the dried tissues of the dead areas break away, leaving holes of all sizes and shapes on the blades of the leaves.

A second kind of symptom is exhibited as small, circular, brown spots which never attain a diameter beyond one-fourth inch, usually being about one-sixteenth inch across. These lesions are characteristic of late infections during the drier months of February, March and April and in the older mature leaves. It is serious in that defoliation is brought about prematurely on the lower part of the bushes, but sound fruits may be found on these. The fungus spores seem to be able also to penetrate the cuticle and epidermis of the midrib and veins producing lesions of a reddish color on most varieties and which may extend for an inch or two. The lesions may extend into the tissues on both sides of the midrib and veins. Long lesions on the midrib may cause the blade to break at that point.

The fungus attacks are quite serious on the petioles of the younger plants. Lesions here are lens-shaped or oval to elongated and sunken. They are brownish at first, then whitish, beset with the black tips of the fruiting bodies the same as the spots on the stems. The fungus sometimes extends from the spots on the petioles down towards the stem where it infects the young shoots which arise at the axils of the leaves. In severe cases the ragged, branchless condition is due to the plant being unable to replace these shoots.

On flowers and fruits the pathogen is very injurious. Flowers and very young fruits seem to be affected late in the season when abundant spores have been produced on the decaying leaves and fruits and on the stem cankers. When the fungus attacks the stalk of the flower or young fruit, the infections cause a shrinking of the tissues. The lesion may extend into the calyx and finally reaches the young ovary or fruit. In any case the ultimate result is the abnormal laying of an abscission layer and the flowers or young fruits drop to the ground. Yet small mummies may be occasionally found attached to the stem. The spots on fruit of all ages and sizes are first evidenced by brownish discolorations of not more than ⅛″ or ¼″ in diameter, usually of regular outline. Necrotic areas will appear at any point on the surface of the fruit but more frequently near the stem end. The fungus spores seem to lodge under the calyx lobes where ideal conditions for their incubation appear to exist. From there the dead areas spread in all directions, finally resulting in the destruction of the fruit. The symptoms will more frequently appear on overhanging fruit which touches the ground.

External symptoms on seed are seldom found. It has been definitely established (Sherbakoff **18**), that the fungus is carried with the seed. It is not very likely that seed may be separated into healthy and diseased. Usually seed from diseased fruit has all the appearance of normal healthy seed from sound fruit. It is only in very advanced cases of rotting that seed will be discolored.

Seedling stage.—On seedlings the morphologic symptoms given above for leaves and stems on full-grown plants usually exist. The rather crowded condition which prevails in the seedbeds is an influencing factor in determining the loss to seedlings. In very young seedlings an affection similar to that produced by the fungus *Pythium de Baryanum* Hesse, a bending-over resulting from the destruction of the young tissues at the surface of the ground, is produced.

Signs.—Pycnidia of the pathogene appear abundantly on the surface of lesions on stems, leaves and fruits. They are formed just beneath the epidermis, their beaks, when developed, extending beyond the surface. Ordinarily, beaks do not appear on the natural host except on very old lesions on plant parts which have dropped to the ground. However, they readily form on certain artificial media.

Histologic symptoms.—The most striking histologic symptoms is a hydrosis of the recently infected parts. The epidermal cells are the first to manifest this symptom and are followed in succession by the underlying cortex cells. The cells of the epidermis are more or less plasmolized. The cell walls of the epidermis as well as those of the cortex cells as far inward as the two or three outer layers of cortical parenchyma are stained brown. This discoloration of the cell walls has not been found to reach as far as the vascular bundles. In the case of lesions on the veins of the leaves and in the fruit, discoloration of the vascular bundles has been observed. In the small lesions on veins of leaves the fungus seems to stop its course after a short period of development. In the fruit the pigmentation is soon destroyed, the brown discoloration then appearing.

ETIOLOGY

Name, history and classification of the pathogene.—A number of diseases have been described on the eggplant which are probably identical. It is natural that various names should have been applied to the causal agent. In 1881, Spegazzini (**22**) described a new fungus on the eggplant leaves and fruit which he named *Phyllosticta hortorum.* Halsted (**6**) accepted this name for the fungus which he found in New Jersey in 1890 on leaves and fruit of the same plant. Halsted further attributes the damping-off or seedling stem-blight to *Phoma solani.* He evidently established differences between the various stages of the disease. It will be shown that the same fungus is able to produce lesions on all above-ground parts and in plants of all ages and therefore only one name should hold, either *Phyllosticta hortorum* Speg. or *Phoma solani* Hals. In 1904, Smith (**20**) reported the fungus *Ascochyta lycopersici* Brun, as different from what had been described as *P. hortorum* Speg. He found differences in size and septation of the spores and in the symptoms of the leaves. In a later paper Smith (1905) was of the opinion that the seedling blight was also caused by this fungus. This year he regarded *Ascochyta lycopersici* and *Phyllosticta hortorum* as one and the same fungus. If they are really so and there is septation of the spores, then the former name would prevail and as Harter (**13**) rightly concluded, the name *Ascochyta hortorum* (Speg.) C. O. Smith should hold, for reasons of priority.

Voglino (**25**) extended into a consideration of the pathogene and designated his Italian fungus as *Ascochyta hortorum* (Speg.) Smith. Later, Harter (**13**) after examination and study of material from New York, Nebraska, New Jersey and Wisconsin found that the fungus was characteristically a member of the genus *Phomopsis.* His work is very illuminating. He concluded that this fungus and *Phoma solani* Hals. are identical. Saccardo and Sydow (**15**) had given the name *Phoma vexans* to Halsted's fungus because *Phoma solani* had already been applied to another species. Harter (**13**) then made his new combination *Phomopsis vexans* (Sacc. and Syd.) Harter. Harter had sent material to Spegazzini for comparison with type specimens of *Phyllosticta hortorum* and the latter apparently found them to be different. Therefore, Harter concluded that *Phyllosticta hortorum* had not been found in the United States. But Smith (**20, 21**) had found an *Ascochyta* and a *Phyllosticta* and had later accepted both to be the same fungus; and Voglino (**25**) had accepted Smith's views. Harter (**13**) was of the opinion that Smith had both an *Ascochyta* and a *Phyllosticta* on the same host. The latter would now be replaced by *Phomopsis vexans.* From host relationships and morphologic characters it appears that both Smith and Voglino had an *Ascochyta* which in Harter's opinion was *Ascochyta lycopersici* and hence distinct from the eggplant blight fungus.

The pathogene to which the disease is attributed in Porto Rico is characteristically *Phomopsis vexans* (Sacc. & Syd.) Harter. The fungus was not compared with any other from abroad because the writer thinks it has been thoroughly worked out by Harter and any further study on the taxonomic position would be a mere duplication of carefully done work. However, it has been given some attention.

Edgerton and Moreland (**4**) consider that the fungus exhibits variations in Louisiana in the manner of infection, rate and manner of growth and ratio of the two kinds of spores. We have not found much variation in our fungus. That apparently two kinds of spots were produced on the same plant made the writer believe that there might possibly be two strains of the fungus. Not less than fifteen isolations from each type of lesion were made. All these pedigree cultures were compared in three media, oatmeal agar, corn flour agar and one per cent dextrose nutrient agar. The rate of growth of the different cultures is not given here because of the uniformity throughout. All the cultures produced a rapid growth in the dextrose agar, forming a thick creamy mycelial stratum over the medium which filled the entire dish (90 mm.) in seven days. Fruiting bodies were scanty in this medium and were formed on the edge of the colonies. In oatmeal agar and corn flour agar growth of mycelium was very slow. The size of the colonies was about 60 mm. in diameter on the seventh day in the oatmeal agar and about 50 mm. in the corn flour agar. Stromata began to develop in these media on the fifth day and large numbers had appeared on the twentieth day. The stromata are black. One to several pycnidia arise in each stroma in these media. The pycnidia are typically beaked. The beaks are from 1 mm. to 1½ mm. in length extending beyond the surface of the stromata.

The same cultures were used in cross-inoculation tests on egg-plant leaves and fruit. It was found that all the cultures from the supposedly different strains invariably produced the same symptoms when inoculated into these plant parts. The inoculations on leaves were made during rainy weather and the spots which resulted were of the large, irregular type. In no case was the small, circular spot reproduced. The writer, therefore, believes that the Porto Rican fungus is more or less uniform.

Harter's (**13**) description of the pathogene, p. 338 of his paper, is here given:

"*Phomopsis vexans* (Sacc. and Syd.), n. comb.
Phoma solani Hals., not *Phoma solani* Cooke and Hark.
Phoma vexans Sacc. and Syd.
Ascochyta hortorum (Speg.) C. O. Sm. not *Phyllosticta hortorum* Speg.

"On the foliage and stems pycnidia loosely gregarious in more or less definite spots, on fruit compact, at first buried, later erumpent, black without, beaked, flattened or irregular in shape, on leaves and stems 60 to 200 microns broad, on fruit 120 to 350 microns broad; pycnospores subcylindrical, somewhat acute, 5 to 8 by 2 to 2.8 microns, continuous, hyaline, 2-guttulate, rarely 3; basidia simple, short, straight or slightly curved, hyaline, continuous; stylospores filiform, curved, rarely straight, 13 to 28 microns long."

Stylospores were infrequently found in our material, both from culture or from the lesions on the various affected parts. Pycnidiospores are generally found. The size of the latter as figured on the basis of 400 spore measurements is 5 to 8 × 1.3–3 microns. The size of the pycnidia agrees more or less with that given by Harter.

LIFE HISTORY

So far as known the fungus *Phomopsis vexans* is propagated asexually throughout its entire cycle.

Primary cycles may originate in the seedbed or in the field on leaves, stems, flowers or fruits.

PATHOGENESIS

Inoculation.—The fungus growing in a saprophytic condition in decaying vegetable matter gives origin to pycnidia where the asexual spores are produced in great numbers. These and the mycelium itself are the sources of the inoculum of the primary cycles.

Incubation.—None of the investigators that have dealt with this pathogene have ever succeeded in germinating the stylospores. The pycnidiospore (Phyllosticta type) germinates readily in distilled water or nutrient solutions at room temperaure in three and one-half hours. At the end of five hours germination is at its maximum.

The germ tube of a spore germinating on any above-ground plant part, either enters through a stoma or through a wound or penetrates through the cuticle into the epidermal cells.

Infection.—Infection begins in the epidermis. The germ tube becomes thicker and much branched in the epidermal cell. The branches invade the surrounding epidermal and cortex cells. The hyphae pierce through the walls of the cells, becoming slightly constricted at the point of passage into the next cell. In the larger parenchyma below the cortex the hyphae become profusely branched. (See plate VII, fig. 1). The whole cortex is soon involved and destroyed resulting in a sinking of the collapsed epidermis.

SAPROGENESIS

Phomopsis vexans is capable of a saprophytic existence in the soil. The fact that the disease has made its appearance in fields on new land which had never grown any Solanaceous species except tobacco, indicates that the fungus is susceptible of a prolonged saprophytic condition, although there exists the possibility of a wild non-solanaceous plant harboring it. In this phase pycnidia are probably produced abundantly and there is the least doubt that primary cycles originating on fruits and leaves are set up by the pycnidiospores from the saprophytic mycelium.

Secondary cycles are repeatedly occurring in a field where the pathogene is present. Pycnidiospores from lesions on decaying plant parts such as leaves from infected seedlings, affected flowers or fruit and stems start the secondary cycles. The most severe injury to plants is caused by these cycles.

EPIPHYTOLOGY

Outbreaks of the eggplant blight occur in Porto Rico at almost any time throughout the year if eggplants are grown. The writer has observed the disease during all the months between September and March. During one year (1927) when a crop was grown during the summer the plants were severely attacked towards the end of the season, in July and August. The temperature which prevails for the whole year seems to be adequate for the production of spores and their germination. Moisture probably regulates the appearance of the malady. Severe outbreaks always follow periods of light or heavy rainfall.

CONTROL

It is very likely that control of this serious affection of the eggplant can be effected through crop rotation. Edgerton and Moreland (**4**) believe that a three-year rotation will be necessary.

Eradication through destruction of the after-crop is probably of little value in heavily infested fields. Much will be gained, however, if seedlings which show symptoms of the disease are destroyed as soon as detected. The removal of any plant in the field which bears the characteristic lesions should also be practiced. The fungus may be partially eradicated by seed treatment. It is a known fact that the mycelium of the fungus is actually present in the interior of the seed. This makes the effectiveness of treatment less likely.

The first treatments of seed for the control of *P. Vexans* were made by Sherbakoff (**17**) in 1916 using 1:10 formaldehyde solution for 10 minutes at 60° to 70° F. and 1:1000 corrosive sublimate for the same length of time at 80° to 85° F. He did not arrive at any conclusions that year. The same writer reported in 1927 (**18**) a 7 per cent contamination from non-disinfected seed and only more than 1 per cent for that disinfected in 1:1000 corrosive sublimate solution for 10 minutes. Sherbakoff (**19**) again in 1918 made further studies with the disease and found that 1 per cent copper sulphate solution for five minutes destroys various bacteria and partly destroys saprophytic fungi on the surface of the seed. *Phomopsis vexans* was not affected by the treatment. Burger (**2**) in 1926 recommended the use of a 1:1000 corrosive sublimate solution for eight minutes for the disinfection of eggplant seed. He did not state which fungus he had in mind but it is assumed it was *P. vexans*, since work had been done previously with this pathogene in that Station. Edgerton (**4**) had reported in 1921 unsuccessful results in the elimination of *P. vexans* from seed by the use of a solution of one part commercial formaldehyde to 300 parts of water. The seed was kept in the disinfectant for fifteen minutes. He concluded that the formaldehyde treatment reduces the infection slightly but does not eliminate it.

From our own experience with the disease for three years we find it inadvisable to carry on treatments of seed. The results of tests made by other writers as given above shows that the mycelium within the seed is hard to be reached by any of the known practical disinfection methods. It seems more reasonable to insist on getting clean seed which comes from sound fruit. The production of clean seed is within the bounds of possibility. If seedsmen do not furnish seed guaranteed as coming from a clean source then the grower should grow his own seed. It is possible for him to select a number of good sound fruits and remove the seed which he can store away until the following season.

When growers do not grow their own seed and have to depend on unreliable sources, the next best thing to do is to exercise strict care in the seedbeds.

When clean, disease-free seed is sown on non-sterilized soil and the pathogene lives in that soil we are sure to get the seedling stage of the blight. In order to test the effectiveness of soil disinfectants in the control of the disease the following experiment was conducted.

Nine beds, 20′ × 3′, the soil of which was known to be infested with *Phomopsis vexans* because a previous crop on the same beds had been seriously affected, were treated in the following manner: The first, second, third, seventh, eighth and ninth beds were drenched with a 1–50 formaldehyde solution, at the rate of one-half gallon per square foot of soil surface. The fourth and sixth beds received a drench of 4–4–50 Bordeaux mixture and the fifth bed remained as check. The seed was sown a week after treatment of the beds. Counts were made at time of appearance of symptoms in the untreated bed, at time of removal of seedlings to a second bed and at time of transplanting. In the case of the check bed, bending-over of the seedlings occurred at an early age. The affected seedlings were removed and counted at that time. Tissue plantings from the tender stems of the affected lesions were made on artificial media to verify the presence of *P. vexans*. The organism was recovered in each case. The results of counts made at various intervals are collected and given in Table III. The large numbers of seedlings obtained in the beds may be accounted for by the fact that a considerable number was transferred to a second bed as soon as they developed two pairs of leaves. The second set of beds where these seedlings were planted and kept for five or six weeks before setting out in the fields, were sterilized in a manner similar to that given before. Of eighteen beds, twelve were treated with formaldehyde, four with Bordeaux mixture and two left untreated. The seedlings coming from the formaldehyde-treated beds were naturally transferred to those beds of the second set which had also been treated with formaldehyde. The same was true for the Bordeaux and check plots. In the second set of check plots, were planted only those seedlings from the check of the experiment which did not show any symptoms of the disease at the time of the transplanting from the treated beds. It should be noted that the seed used in this experiment was obtained from sound fruit grown by us.

TABLE III

EFFECT OF SOIL STERILIZATION ON THE SEEDLING BLIGHT OF THE EGGPLANT

Bed No.	Treatment October 15, 1928	Results—Seedlings			
		Healthy	Diseased	Total	Per cent diseased
1	1–50 Formaldehyde	6585	23	6608	0.35
2	1–50 Formaldehyde	5689	0	5689	No
3	1–50 Formaldehyde	6781	42	6823	0.62
4	4–4–50 Bordeaux	5007	892	5897	15.13
5	Check	51	6268	6319	99.19
6	4–4–50 Bordeaux	4989	1236	6225	....
7	1–50 Formaldehyde	5437	0	5437	No
8	1–50 Formaldehyde	6897	37	6934	0.53
9	1–50 Formaldehyde	4979	0	4979	No

From an interpretation of the results of Table III it is evident that infested soils should not be used for eggplant seedbeds. Infested soils can be rendered safe for seedbeds if treated with formaldehyde, 1–50 solution at the rate of one-half gallon per square foot of soil surface. Very few plants were found with the disease in beds treated in this way. An application of 4–4–50 Bordeaux mixture at the same rate as the formaldehyde solution gives fairly good results. The formaldehyde treatment is to be preferred because it practically eliminates the infestation and prevents secondary cycles. In the Bordeaux mixture treated beds some of the fungus escaped the action of the disinfectant or survived it, and spread rapidly over a large number of seedlings. The cost of the formaldehyde treatment in Porto Rico is as follows:

Formaldehyde (cost of material delivered at the Station), 11 gallons enough for 18 beds (20′ × 3′)	$24. 75
Labor (application of formaldehyde)	3. 00
Total	$27. 75

This is the additional expense incurred when growing seedlings and does not include the cost of land, cultivation, etc.

Twelve beds were used as transplant beds as has been previously stated. These beds held about 900 seedlings each, the latter had been set at 3 inches apart each way. The twelve beds made a total of 10,708 seedlings. An examination of Table III will show that the six formaldehyde-treated beds yielded a total of 36,368 healthy seedlings. Those 10,708 seedlings in the twelve transplant beds given above proceeded from these 36,368 seedlings. The difference of 25,660 were left in the original beds and from there removed to the fields at intervals. From this number should be deducted nearly 2362 seedlings which were discarded from the original beds and which made up the number of diseased seedlings and those not planted because of poor development. The total of healthy seedlings, that could be used safely for planting was 34,006 and would have been sufficient to plant about five and one-half acres. The planting distances on which this calculation is based is three and one-half by two feet. The additional cost would have been about $4.50 per acre. A grower can easily afford this expense.

CONTROL BY PREVENTION

Attempts at the prevention of the malady were made as early as 1893 by Rolfs (**14**) who employed Bordeaux mixture and ammoniacal copper carbonate. No results are recorded. In 1895 Halsted (**7**) used Bordeaux mixture (5–5–50), Eau celeste (1–1½–50), copper sulphate (1. oz. to 8 gallons) and sulphide of potassium

(1 oz.–2 gallons) in an attempt to control the disease. Bordeaux was the only disinfectant which was satisfactorily applied. In 1896 the same writer (**8**) reported the testing of soda-Bordeaux, potash-Bordeaux and the 5–5–50 Bordeaux of his preceding year with the latter alone giving satisfactory control. The following year he (**9**) repeated the experiments adding this time a fourth fungicide, cupric hydrate, to those used in 1896. This year he found "little difference in the effectiveness of the four fungicides". In 1899 (**10**) Bordeaux and soda-Bordeaux were used but the number of fruits was not sufficient to be used in arriving at any conclusions. Halsted's (**11**) experiments of 1900 showed Bordeaux sprayings resulted in "less infested" plants and "somewhat larger" yields.

In 1921, Edgerton and Moreland (**4**) reported the results of four experiments with 4–4–50 Bordeaux mixture. Up to 13 applications of the mixture were made during a single season. There was a consistent increase in yield with applications of the fungicide but they concluded that it may not be practical to spray in Louisiana. Furthermore they found that "a few applications of the spray solution seem to have had no good effects". Yet they believe that in climates with less rainfall it may be profitable to spray.

Bordeaux mixture (4–4–50) has also been recommended by Bruner (**1**) in Cuba. Geise et al (**5**) reported in 1922 successful results in the control of *P. vexans* with copper lime dust and 4–6–50 Bordeaux mixture with 2 pounds powdered calcium arsenate. They obtained equally good control with both the dust and the spray. Spencer et al (**23**) found that Bordeaux with arsenicals gave satisfactory results. Bordeaux with zinc arsenite gave as good and in some instances better results than Bordeaux with calcium arsenate. Bordeaux dust with 20 per cent calcium arsenate was superior to Bordeaux dust alone or to the Bordeaux calcium arsenate spray (4–8–2–50).

It was deemed necessary to have a knowledge of the treatment for the control of the disease under the conditions which prevail in Porto Rico and especially in relation to its cost and practical application. One experiment was carried out in order to ascertain whether the blight of seedlings could be prevented by sprays. Three beds, 20′ × 3′ each, were planted with eggplant seed as follows: the first bed, sterilized with formaldehyde and sown with seed coming from diseased fruits; the second bed, divided into two sections across the middle, in one section (*a*), the soil being sterilized with formaldehyde, and seed from diseased fruits employed. The second section (*b*) had soil which was known to be infested with the blight organism. Here seed from sound fruit was used. The third bed had soil known to be also infested with the pathogene and in it seed from sound fruit was used. Seed was planted on October 3, 1928. The first and third beds were sprayed every week with Bordeaux mixture (4–4–50), the first application being made on November 1st., when the first symptoms of the disease appeared. The second bed remained untreated. As soon as symptoms appeared on seedlings these were removed from the bed in order to reduce the source of inoculum as much as possible. A total of five treatments were made. At the time the fourth treatment was applied, Nov. 21, a large number of the healthy seedlings were of transplanting size and age and were removed from the beds. An additional treatment was then necessary for those which would reach the desired size in a week or two more. The results accumulated by the time when the majority of the plantlets were of the proper size for transplanting are given in table IV. The number of seedlings in the beds were small due to the fact that the sowing was made quite sparse.

TABLE IV

RESULTS OF 4–4–50 BORDEAUX TREATMENT FOR THE PREVENTION OF THE SEEDLING BLIGHT

Bed	Treatment	Seedlings			
		Healthy	Diseased	Total	Per cent Diseased
1 Formaldehydetreated. Seed from diseased fruit........	4–4–50 Bordeaux	3231	893	4124	21.41
2a. Formaldehyde-treated. Seed from diseased fruit......	Check..........	1468	1509	2977	50.69
2b. Infested soil Seed from sound fruit..............	Check..........	1891	1686	3577	47.13
3. Infested soil. Seed from sound fruit...	4–4–50 Bordeaux	3818	632	4450	14.20

The highest percentage of diseased seedlings (50.69 per cent) was on the bed with sterilized soil but where infested seed was employed. The infection in the untreated bed, with clean, sound seed, was lower only by a narrow margin.

It is plain that Bordeaux mixture has highly beneficial results in seedling blight prevention. When infested seed was used the effectiveness of the treatment was much reduced.

Notwithstanding the fact that rather fair control can be obtained by prevention we are of the opinion that one should rather endeavor to eliminate the infestation in the soil as has been recommended in the preceding paragraphs. One can easily see how apparently healthy plants may be carriers of the spores of the fungus which will infect the suscept when transplanted. A small amount of the diseases in a bed is a menace to the healthy seedlings in the same bed unless these are thoroughly wet with Bordeaux mixture previous to pulling for transplanting. Experience tells us that it is only with considerable difficulty that the fungicide is made to reach every above-ground part of the seedling. This is because of the rather crowded condition which holds during the fifteen or ten days which precede the operation of transplanting.

Experiments have been made to ascertain whether control of the disease in the field is possible and practical in Porto Rico. Bordeaux mixture of the formulas 4–4–50 and 3–3–50, and copper lime dust have been tried out. The results with the dust are to a certain degree misleading and will be omitted. Further and more extensive trials should be made before conclusions are drawn.

The plan of the experiments has been as follows. An examination of the field was made when the plants had developed about six leaves, this number including only one of the leaves of the partially expanded growing bud. All leaves that showed symptoms of the disease were gathered. At the time of the removal of the diseased leaves, records were taken of the number of diseased plants, number of diseased leaves, number of unaffected plants, number of plants with all leaves diseased, and the number of lesions on the leaves. These counts were made in order to have an idea of the general infestation of the field at the time of the first application. The number of lesions will give an idea of the number of inoculations, each spot representing, in our judgment, a distinct inoculation. The diseased leaves were removed from the field in order to make sure that any new lesions came as a result of inocula from other than the primary cycles.

In each experiment two rows on the edge of the particular field were kept as checks.

The results appear in Table V.

TABLE V

SHOWS RESULTS OF TREATMENTS FOR THE CONTROL OF EGGPLANT BLIGHT AND FRUIT ROT

	4-4-50 Bordeaux	3-3-50 Bordeaux
Total number of plants	1497	894
Total number of untreated plants (check)	63	121
Total number of treated plants	1434	773
Total number of plants with diseased leaves prior to treatment	517	396
Percentage of diseased plants	36.05	44.29
Total number of leaves	6674	5244
Total number of diseased leaves	979	935
Percentage of diseased leaves	14.67	17.83
Total number of lesions on leaves	6601	5002
Ratio of lesions to leaves	6.74:1	5.35:1
Total number of fruits at end of season on treated plants	6115	3772
Total number of sound fruit on treated plants	5976	3581
Total number of diseased fruits on treated plants	139	191
Percentage of sound fruit in treated plants	97.73	94.94
Percentage of diseased fruit on treated plants	2.27	5.06
Total number of fruits in "check rows"	137	206
Number of sound fruits in "check rows"	21	42
Number of diseased fruits in "check rows"	116	164
Percentage of sound fruits in "check rows"	15.33	20.39
Percentage of diseased fruits "in check rows"	84.67	79.61

An examination of Table V makes clear that the infestation of the three fields was very heavy. On the basis of number of plants the infection varied from 36.05 per cent to 44.29 per cent while on the basis of diseased leaves it would be much lower, 14.67 per cent to 17.83 per cent. The latter will probably better indicate the amount of infection at the time the treatments were made. The total number of lesions offers a still clearer idea of the general conditions of infestation. The counts of the lesions in all the diseased leaves throws a ratio of from 6.74 lesions per affected leaf to 5.35. This ratio is a clear expression of what was occurring in the fields at the time the treatments were made. Had no applications of fungicides been made the disease would surely have spread from the diseased to the unaffected plants.

The effect of the fungicides is calculated on the basis of sound to diseased fruit rather than on healthy or diseased foliage because of the difficulty in counting the leaves of the full grown plants throughout the season. A comparison of the results obtained with 3–3–50 or 4–4–50 Bordeaux mixture shows that the latter is more effective under more or less the same conditions of infestation. With the 4–4–50 Bordeaux mixture there were 97.73 per cent sound fruit as against 94.94 per cent for the 3–3–50 Bordeaux-treated field. The results in the check rows although with smaller numbers, show clearly the danger to which the plants are exposed when no protection is employed.

The cost of Bordeaux mixture (4–4–50) and of its application at the Experiment Station are given here. These figures will apply to many sections of the island. The cost will, of course, vary according to the cost of labor and cost of transportation.

The cost of eight applications of the mixture was as follows:

43 pounds of copper sulphate at 7.7¢	$3.31
43 pounds of live lime CaO) at 1.8¢	.77
Cost of application, 118 hours of labor at 12.5¢ per hour	14.75
Depreciation of sprayers, estimated	2.00
Total cost of spraying 1,497 plants	$20.83
Cost per 1,000 plants	$13.91
Cost per 6,000 plants in about one acre	83.46

We have found that the cost of spraying eggplants in Porto Rico is highly prohibitive under ordinary conditions. Unless the cost of application is reduced it seems that our growers will not be justified in spraying. The solution of the problem of the cost of treatment lies in cheaper application or fewer applications. During certain years it may not be necessary to make as many as eight applications.

Probably the cheapest and safest plan of control of the blight and fruit rot is to grow healthy seedlings in the manner suggested in the preceding paragraphs and plant them in uninfested soils.

SUMMARY

1. A serious disease of eggplants known in Porto Rico as "lunares de la hoja y tallo" and "podredumbre de la fruta", in the United States of North America as leaf blight, foot-rot, leaf-spot, stem-blight, fruit-rot, eggplant-blight and seedling-stem-blight and in Cuba as "mancha de la hoja" and "enfermedad del tallo" exists in Porto Rico.

2. All varieties of eggplant are more or less equally susceptible under Porto Rican conditions. Color of plant or of fruit has no bearing on susceptibility or resistance.

3. The disease usually brings a loss of 50 per cent or over of the crop.

4. The symptoms of the disease appear on all above-ground parts of the plant. A seedling blight, stem and petiole cankers, spots on

leaf blades, fruit stalks and calices and a rotting of the young and mature fruit are produced.

5. The fungus may occur inside the seed.

6. The pathogene responsible for the malady is *Phomopsis vexans* (Sacc. & Sydow) Harter.

7. Variations of the fungus as have been observed elsewhere do not appear to occur in the fungus in Porto Rico.

8. The size of the pycnidiospores ranges from 5 to 8 microns in length to 1.3 to 3 microns in width.

9. The germ tube of a germinating spore may either enter through a stoma, enter through a wound or force its penetration through the cuticle.

10. Secondary cycles repeatedly occur in fields.

11. The fungus is capable of a saprophytic existence.

12. The prevailing temperature in Porto Rico seems adequate for spore germination.

13. Moisture is a very important factor in outbreaks of the disease.

14. The disease is probably controlled by a three- or four-years rotation.

15. Plants with the symptoms of the disease should be promptly removed from fields.

16. Although seed treatment is beneficial it never completely eliminates the pathogene.

17. Clean seed from unaffected fruit should be demanded.

18. Infested soils should be avoided in preparing seedbeds.

19. Inoculated soils can be rendered safe for seedlings if drenched with a 1–50 formaldehyde solution at the rate of one-half gallon per square foot of soil surface. An application of 4–4–50 Bordeaux mixture is highly beneficial but the formaldehyde treatment is to be preferred. The latter treatment will cost about two-thirds of one cent per seedling.

20. Bordeaux mixture (4–4–50) is quite effective in preventing seedling blight. The treatment is too expensive and therefore inapplicable under ordinary conditions. Bordeaux mixture may be of practical application where labor cost is reduced. The safest and cheapest control measure is to grow healthy seedlings and set them out in uninfested soils.

The writer wishes to express his appreciation to Dr. Melville T. Cook, Chief of the Division of Plant Pathology and Botany, for help in the final preparation of the manuscript.

EXPLANATION OF PLATES

PLATE VII

Fig. 1. The fungus hyphae penetrating a cortical parenchyma cell from two adjacent cells. Note luxuriant growth inside the cell and the constriction of the hyphae at place of entrance.

Fig. 2. A fungus hypha in the cells below the epidermis.

Fig. 3. Conidiophores and conidia of *Phomopsis vexans* (drawn from the high power magnification).

Fig. 4. Germinating conidia (drawn from the oil immersion).

Fig. 5. Two plants affected with *P. vexans*. Note that there is only one healthy branch on the plant to the right. Stems, fruit and leaves, all severely infected.

PLATE VIII

Fig. 6. Lesions on stems. Note the black fruiting bodies on the whitish background of the lesion.

Fig. 7. Mummified fruits. Note that mummies are produced from fruits of all ages.

PLATE IX

Lesions on fruits of all sizes and age. Note the fruiting bodies on the fruit at the upper right hand corner.

PLATE X

The lesions on the leaves. Note two types of spots and also the fact that lesions are produced on the veins and parts of the blade between the veins.

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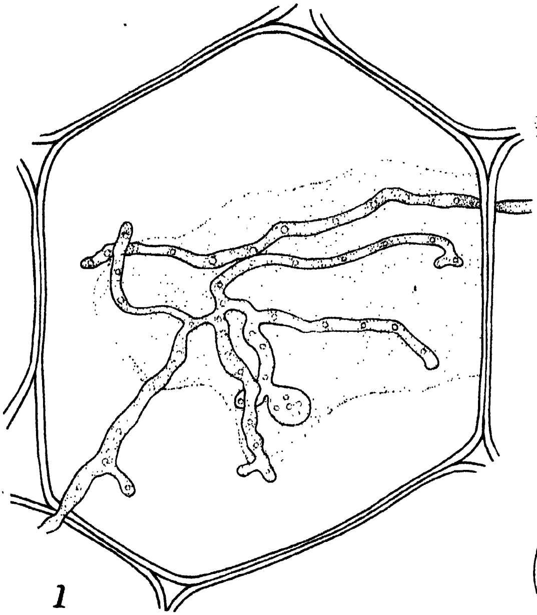

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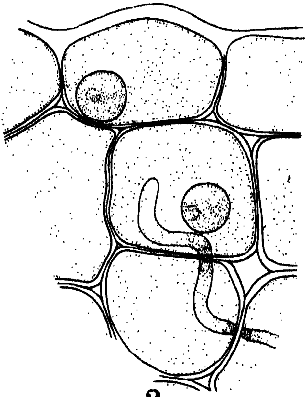

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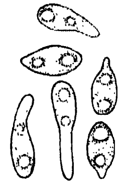

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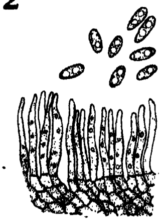

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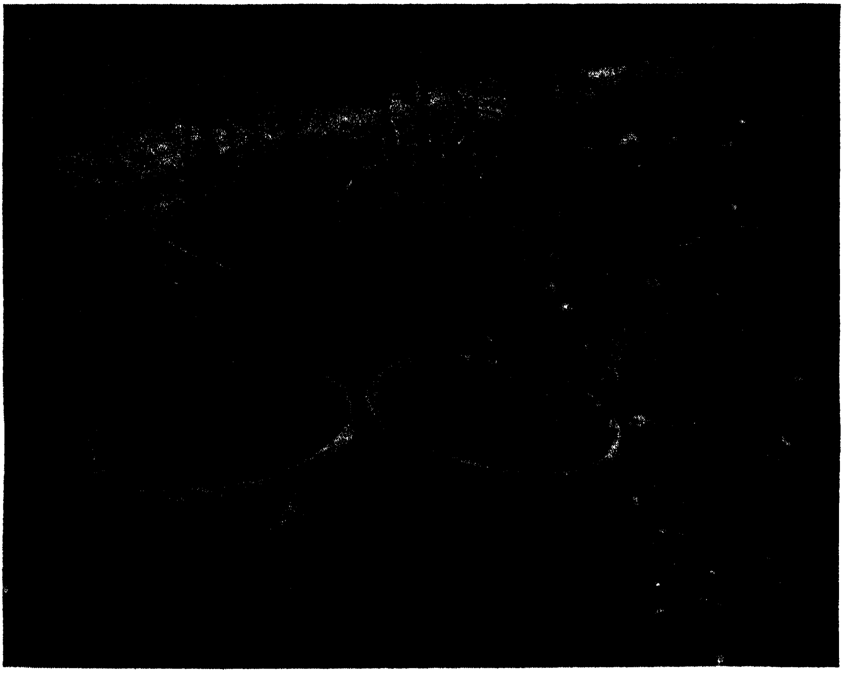

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PLATE IX.

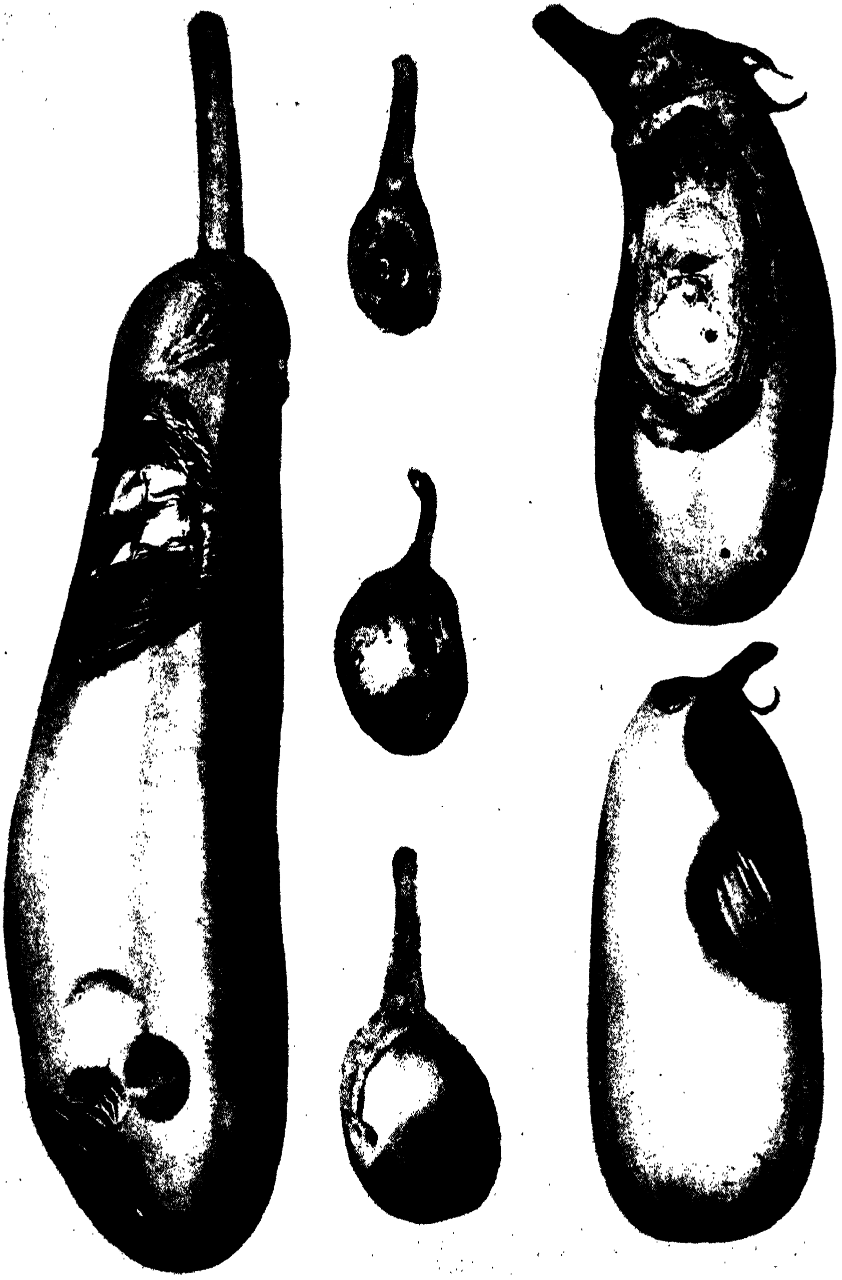

PLATE X.

ACROSTALAGMUS APHIDUM OUD. AND APHID CONTROL

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The control of aphids through fungous parasitism has attracted much attention during the last two decades. Johnston (**1**) was the first one to call attention to the existence of fungi on aphids in Porto Rico, which he regarded as important in the control of this pest. The present paper deals with a study of *Acrostalagmus aphidum* Oud. with special reference to its use in the control of some plant lice.

In 1915 Jones (**3**) reported the fungus *Acrostalagmus albus* Preuss. on the sugar cane aphid *Sipha flava* Forbes. During the same year Johnston (**2**) in his description of the entomogenous fungi of Porto Rico gave this fungus on various hosts. In 1926, the writer's attention was called to the parasitizing action of this fungus on the aphids of the melon in a planting in the interior of the island. Preliminary studies were made that year. These were followed by more extensive field trials in 1927 and 1928. Because the fungus and been reported in Porto Rico under the name of *Acrostalagmus albus*, and the description did not agree with that offered in Saccardo for that species, material was sent to the United States Department of Agriculture Bureau of Plant Industry for determination. Miss Vera K. Charles of that Bureau, after a comparison with a number of species of Acrostalagmus concluded it was *A. aphidum* Oud. and not *A. albus* Preuss. It should be noted that Johnston (**2**) had found considerable difference between the type and his Porto Rican form but regarded it as "scarcely enough to indicate a separate species." Although the writer finds differences between the morphology of the Porto Rican form and the description in Saccardo, which may be considered enough to erect at least a distinct variety or strain he has retained the name *Acrostalagmus aphidum* Oud.

A study of the fungus has been made both on its natural and on artificial strata. Normally a profuse white to creamy mycelium develops on the surface of the parasitized insects. The mycelial threads are slender, siphonaceous, mostly dichotomously branched. Asexual spores are abundantly produced on erect fertile hyphae.

These spore-bearing threads are occasionally septate but more usually continuous. They fork out into three to four branches two or three of which bear spores at the tips and one usually grows out and branches again giving rise to more condiophores (see Plate XI, fig. 10). The usual number of these branches is three. Conidia are borne singly or in heads (see Plate XI, fig. 7–10). They are oblong, cylindrical or elliptical, obtuse on both ends or slightly pointed at one, hyaline, non-septate; the size of the Porto Rican form varies from 3–14 × 1–4 microns, and has a mean of 7.259 ± 0.0717 × 2.47 ± 0.02 microns. The exact manner of head formation has not been clearly established. From observations of germinating spores if seems that the spore heads are formed as follows: The first conidium formed becomes detached from the tip but does not fall off. It seems to be enveloped by some sort of a mucilaginous substance which prevents it from falling off. A second conidium is produced at the tip, and others follow in succession all remaining together in a head-like structure held by an apparently evanescent film (see Plate XI, fig. 8).

Measurements of conidia were made from various hosts. The differences found in the size of the spores from the various natural strata (different species of aphids) are insignificant. Some of the results appear in Table I.

TABLE I

LENGTHS AND WIDTHS OF CONIDIA IN MICRONS—FUNGUS ON THREE DIFFERENT STRATA

Stratum	Lengths				Widths			
	Minimum	Maximum	Modal class	Mean	Minimum	Maximum	Modal class	Mean
Okra aphid	3.95	11.84	6.0	7.055 ± 0.0699	1.32	3.42	3.0	2.616 ± 0.271
Eggplant aphid	3.45	13.11	7.0	7.259 ± 0.0717	1.04	3.45	2.5	2.47 ± 0.020
Oatmeal agar	3.16	10.52	6.0	6.028 ± 0.055	1.32	2.63	2.0	2.265 ± 0.022

A biometrical consideration of the results indicates that the difference in mean spore lengths in the fungus growing on the bodies of the eggplant aphid and that on the oatmeal agar is significant, about thirteen times its error; as is the difference between the okra aphid fungus and the fungus on the oatmeal agar, its error being contained in it about 11 times. On the other hand the little difference between the okra aphid and the eggplant fungus spore mean lengths falls within the limits attributed to random sampling. In the mean widths of spores, however, it appears that there is only a significant difference, seven times its error, between the fungus on the eggplant aphid and the culture on oatmeal agar. Here the greater mean width is found in the former and agrees with the results on lengths of spores.

A further consideration of the figures on the table shows that our measurements vary somewhat from those given in the original description for *A. aphidum* Oud. Thus, there the size of conidia is given as 7–14 × 2.5 microns. Our results show a wider range of spore length and width. From the table we find that the measurements for the Porto Rican fungus are 3–14 × 1–4 microns with a mean size of 7.259 ± 0.0717 × 2.47 ± 0.02 microns.

The description of the fungus is here inserted as taken from Saccardo's "Sylloge Fungorum":

"*Acrostalagmus aphidum* Oud. Beitr. Bot. Centr. 1902, p. 15. Syll. 18: 536–37. Caespitibus effusis, tennibus, albis, hyalinis; hyphis sterilibus repentibus, ramosis, continuis; fertilibus erectis, sursum trifucatis, ramis secundariis primario aequilongis v. longioribus, continuis, summo subulato, capitulo conidiorum capitato-aggregatorum, muco conglutinatorum 12–16 micr. diam. one-ratis; conidiis oblongis, hyalinis, continuis, cylindraceis, rectis, utrinque obtusis, 7–14 × 2.5. Hab. in sceletis Aphideae cujusdam, in superficie foliorum Aristolochiae gigantis in horto botanico Utrecht Hollandiae."

Nederl. Kruidk. Arch. Ser. 3, Vol. 2, p. 759 (1902)

Acrostalagmus aphidum Oud.—Sur les squelettes accumulées d'une Aphidée, a la surface des feuilles languissantes d'un *Aristolochia gigas,* cultivé dans une serre chaude du Jardin botanique d'Utrecht, le 13 Oct. 1900.—Mr. A. Pulle, candidat en histoire naturelle.—Touffes éparses, subtiles, blanches, hyalines sous le microscope. Hyphes steriles rempantes, rameuses, continues; fertiles dressées, trifurquées au sommet, a branches aussi longues ou plus longues encore que la hyphe-mére, continues, pourvues a leur sommet subule d'une agglomération sphérique de conidies, retenues en place par une matiére glutineuse, large de 12 a 16 p. Conidies nombreuses, oblongues, hyalines, continues, droites, arrondies aux bouts, 7–14 × 2–½.

Spore germination.—Studies were undertaken with the object of finding out the optimum conditions for spore germination. In all cases fresh spores were used as the results would give an approximation to what occurs in nature. Drops from a spore suspension in tap water were placed on slides and kept in a moist chamber. In another set the drops were placed in Van Tieghem cells and likewise placed in a moist chamber. Observations showed that the germ tubes began to protrude at the ends, after two hours and forty minutes. A count of the spores that had germinated and those that had not was made at the end of six and one-half hours. Of 884 spores counted in the drops on the slides, 604 germinated and 280 failed to do so. This shows a 68.33 per cent of viable conidia.

It has been observed that some of the conidia become one-to several-septate prior to or after germination. At the end of several hours of germination, conidia are produced at the tips of the branches of the fertile hyphae. In some of the branch tips a bulged-out affair is only formed with no evidence of the conidia. Some of these structures have been seen to function in germination like the conidia (see Plate XI, fig. 7). The heads are soon formed and at the end of ten or twelve hours may contain as many as four or five spores. Some of the young conidia will germinate while still attached to the head-like fruiting structure (Plate XI, fig. 6).

It was observed that some germinating conidia send out dark structures at the end of the germ tubes, which resemble and function like the appresoria of the anthracnoses (Plate XI, fig. 5). These secondary bodies and the germ tubes which bear them become brown. They have always been found where the moisture present during the early stages of germination was lost and therefore development was temporarily arrested. When moisture is restored these germinate by sending out long germ tubes or short, fertile branches. This again likens them to the appresoria of some of the Melanconiales.

Germination in sugar solutions.—Suspension of fresh spores were prepared on 10 per cent sucrose and 10 per cent glucose solutions and in distilled water. Drops were placed on slides and allowed to germinate in the usual manner. Germination started simultaneously in the check and the two sugar solutions. Counts made at the end of five hours showed that 78.365 per cent of the spores in distilled water, 89.795 per cent in the sucrose solution and 97.80 per cent in the glucose solution had germinated. Undoubtedly there was a marked favorable effect of the glucose on germination. Germination was somewhat higher in the sucrose solution than in distilled water. Although the lengths of the germ tubes were not measured at the time, it was clear to the writer that the much longer germ tubes were found on the spores germinating in the glucose solution.

Dessication of spores.—To determine the effect of drying on conidia, a suspension of these was made in distilled water and drops placed on slides. The drops of water were dried from the slides by operating an electric fan. Two slides were left without drying the water film and the spores allowed to germinate in a moist chamber. These served as a check. The slides with the dried films of water were divided in two sets, one of which was placed in dry chambers and the other in moist chambers. Tests for viability of the conidia were made on the following day. Upon examination of the slides in the moist chambers it was found that a considerable number of the conidia had germinated. The same thing happened in the checks. By the third day most of them had sent out germ tubes.

In the dry chamber set, the germinating power of the spores was rapidly lost. On the third day only about 33 per cent were viable; while on the fifth day only 8 per cent retained the germinating ability and on the sixth day none of the spores germinated. It is thus demonstrated that spores germinate readily in the presence of a small quantity of moisture and that their germinating power is hindered by dessication, retaining their ability to germinate for only five days in the absence of moisture.

Effect of aphid extracts on germination.—To ascertain whether extracts of the insect juices had any effect on the rate of germination of conidia, a considerable number of aphids from two hosts were gathered, macerated and the extract obtained in distilled water. The small portions of the bodies of the insects were removed from the extracts. A suspension of fresh spores was then made in each of the two extracts and indistilled water. Drops were placed on slides and those in germinating chambers. The lengths of the conidia and germ tubes were measured at the end of six and one-half hours. The results are given on Table II.

TABLE II

LENGTHS IN MICRONS OF GERMINATING CONIDIA ON VARIOUS MEDIA

Extract of	Lengths			
	Minimum	Maximum	Mode	Mean
Cryptostegia aphid	13.80	124.20	24.15	41.45±0.795
Cyperus aphid	10.35	86.25	24.15	29.60±0.5882
Distilled water	9.35	62.10	13.80	19.159±0.2511

A glance at the table makes evident that a pronounced difference in mean length of tubes exists on germination spores in aphid juices as compared to distilled water. This difference is about 10.44 microns for the spores on the *Cyperus* aphid juice and is about sixteen times its error. The difference between the mean lengths of germ tubes in the *Cryptostegia* aphid juice and distilled water is 22.291 microns which is nearly twenty-seven times its error and therefore highly significant. Further, the difference of mean lengths of tubes in the two juices is 11.85 microns, about twelve times its error. The mean lengths are significant to the point of indicating a stimulating effect of aphid juices on germination and suggesting variations in this influence according to the species of aphids. (See Plate XI, fig. 1–4).

Effect of reaction on growth of the fungus.—The fungus was grown in Bouillon and in a culture solution No. 1 * of pH values ranging from 2.94 to 9.44. The results are given in Table III.

TABLE III

EFFECT OF REACTION ON GROWTH OF *A. APHIDUM*

pH	Solution No. 1	Bouillon
2.94	—	+ — —
3.94	+ —	+ —
4.94	+ +	+
5.98	+ + +	++
6.93	+ + + +	+ + +
7.03	+ + + +	+ + +
7.93	+ + + +	+ + + —
8.90	+ + +	+ +
9.44	+ —	+ —

In the table degree of luxuriance of growth is represented by crosses, four + 's standing for optimum development and +— for slight growth. This organism seems to produce optimum growth in media of the reaction 6.93 to 7.93, from almost neutral to slightly alkaline. Growth ceases in acid concentrations of pH 2.94 and only a slight development occurs in reactions of pH 9.44.

HOSTS

As has been stated before the pathogene was reported on *Sipha flava* (**3**). In 1915 Johnston (**2**) reported the fungus on the following hosts: *Sipha graminis* on *Saccharum officinarum* L., the *Eupatorium odoratum* aphid, and the dead bodies of the aphid on okra

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* *Formula.* Cane sugar 60 gms., ammonium phosphate 0.6 gms., magnesium sulphate 0.25 gms., ferrous sulphate trace, and water to make 1,500 c. c. Reaction adjusted to lower concentrations with tartaric acid.

(*Abelmoschus esculentus,* (L) Moench.). It seems that Johnston made a slight error in giving the sugar-cane aphid as *Sipha graminis.* Stevenson (**4**) in 1918 added *Corythaica monacha* on *Solanum melongena* to the list of hosts given above.

Wolcott (**5**) cites Van Zwaluwenburg (**6**) as reporting *A. albus* on the coffee aphid *Toxoptera aurantiae* Boyer. Table IV gives a summary of the hosts of this pathogene in Porto Rico.

A number of the host plants of the aphids are marked with one or two stars while others are unmarked. Those plant hosts with one star had been reported previously, those with two stars are first recorded here while on those without any star the fungus has not been found or reported as yet. The genera and species of aphids with one star are those first found by the writer to be parasitized by the fungus

TABLE IV

HOST RELATIONSHIPS OF *A. APHIDUM*

HOST OF THE FUNGUS	PLANT HOST
Aphis gossypii Glover	Cotton—*Gossypium barbadense* L.
	* Okra—*Abelmoschus esculentus* (L.) Moench.
	* Cucumber—*Cucumis sativus* L.
	** Melon—*Cucumis melo* L.
	Guava—*Psidium Guajaba* L.
	Cecropia peltata.
	** "Yautía"—*Xanthosoma sagittaefolium* (L.) Schott.
	** "Malanga"—*Caladium colocassia* (L.) W. F. Wight.
Rhopalosiphum persicae Sulzer	* Eggplant—*Solanum melongena* L.
	* Pepper—*Capsicum baccatum* L.
	Sweet potato—*Ipomoea batatas* L.
	Sesame—*Sesamum orientale* L.
Toxoptera auriantiae Boyer	* Coffee—*Coffea arabica* L.
	* Orange—*Citrus sinensis* (L.) Osbeck.
	** Mamey—*Mammea americana* L.
	Cacao—*Theobroma cacao.*
	** Grapefruit—*Citrus grandis* (L.) Osbeck.
	Sea-grape—*Coccolobis uvifera* (L) Jacq.
	Mirto—*Chalcas exotica* (L.) Millsp.
***Sipha flava* Forbes**	* **Sugar-cane—*Saocharum officinarum* L.**
	Sorghum—*Holcus sorghum* L.
	Lemon grass—*Cymbopogon citratus* (DC) Stapf.

HOST RELATIONSHIPS OF *A. APHIDUM*—Continued

HOST OF THE FUNGUS	PLANT HOST
Corythaica monacha Stal. (eggplant lace-bug)	* *Eggplant—Solanum melongena* L.
* *Aphis pseudobrassicae* Davis	** Cabbage—(*Brassica oleracea* L.) Mustard—(*B. integrifolia* (West) O. E. Schulz)
* *Carolinaia cyperi* Ainslie.	** "Coquí"—*Cyperus rotundus* L.
* Undetermined aphid	** *Cryptostegia madagascariensis*
Undetermined aphid	* *Eupatorium odoratum*

Inoculation experiments.—The first work done with this problem was in December of 1926. At that time there occurred a very heavy infestation of the aphid *Rhopalosiphum persicae* on eggplants which were being grown for breeding purposes. The writer discovered a number of plants the leaves of which showed on the under surface an abundance of small white, cushony-like masses, which upon closer examination proved to be dead bodies of aphids covered with mycelium of the Acrostalagmus fungus. Simultaneously the writer had collected melon leaves in Cayey, P. R., which also showed the parasitized bodies of aphids. Cultures were made from the dead bodies of both the melon and eggplant aphids. Cucumber and eggplant seedlings were grown in pots in the green house. When the eggplants had attained a height of eight inches and the cucumber vines were about two feet in length they were exposed for a day in places where it was known infestation of each host would come about. When the plants showed the aphids on the lower surfaces of the tender leaves they were removed to the greenhouse with care not to shake off the plant lice. There the insects were allowed to multiply. The plants were next put inside cages (cheese cloth-lined) and here sprayed with a suspension of the Acrostalagmus spores. This operation was performed on an evening just before sunset. Spores of the fungus both from dead aphids and from corn meal agar cultures were employed. There were in the experiment three sets of eggplant and three of cucumber plants. In each case one set was left as check, a second one sprayed with spores from the corn meal agar culture and the third received the suspension of spores from the fungus growing on dead aphids. After inoculation the cages were kept moist for two days so as to insure adequate moisture relations for the germination of the spores. Daily observations were made. At the end of the third day a few aphids in each inoculated cage were found to show a slight brownish discoloration (not the browning induced by the insect hyperparasites). The number of dead insects increased every day until the end of one week when the majority had succumbed to the attacks of the pathogene. In fourteen days all the aphids in the inoculated cages had died. This experiment demonstrated that either the melon or eggplant aphid fungus had the ability of parasitizing the aphids on either the eggplant or cucumber. The cucumber and the melon aphids are identical. That the melon aphid fungus and the eggplant aphid fungus were one and the same was corroborated by further cross-inoculations on pepper, eggplant, cucumber and melon, and by microscopic examination. The aphid on the eggplant and pepper is the same species. The details of these inoculations are omitted because the method is the same as described above.

It was planned to inoculate as many species of aphids and on as many hosts as could be found in abundant numbers or could be grown in the greenhouse. In November 1927, a number of sprouts arising from a "mamey" (*Mammea americana*) stubble exhibited a curly appearance of their more tender leaves. Upon examination they were found to be covered on the under surface by a considerable number of plant lice. These were soon sprayed on a cool afternoon with a suspension of the spores of Acrostalagmus. Death of the insects was brought about in from six to twenty days. This is a new record of parasitism of the fungus on the species which had been reported (**6**) as attacked on coffee and orange.

In the month of December of that year the fungus was found on okra (*Abelmoschus esculentus*), and again on the melon aphid, on eggplant, pepper and cucumber. Inoculations from each of these were performed on the eggplant aphid with successful infection. The aphid on the okra was also inoculated with the fungus isolated from the dead insects on this host and it also died.

The fungus made its reappearance during the months from October to February (1928–29) on the aphids on the following plants: eggplant, pepper, cucumber and okra. New isolations were made this year and used in the inoculations which are given later.

In December, 1928, a number of "coquí" (*Cyperus rotundus*) plants were examined for the presence of aphids. It was discovered that a number of the insects had been killed by a whitish fungus and *Acrostalagmus aphidum* was suspected as the causal agent. Isolations were made and the cultures employed in cross-inoculation studies.

A search was made for different species of aphids and on different hosts. In January we discovered abundant aphids on the following hosts: eggplant, cabbage, (*Brassica oleracea* L.), mustard (*B. integrifolia* (West) O. E. Schulz), "coquí" (*Cyperus rotundus*), "yautía" (*Xanthosoma sagittaefolium* (L.) Schott), "malanga" (*Caladium colocassia* (L.) F. W. Wight, *Cryptostegia madagascariensis* (a recent introduction from the botanical garden of Panama, Central America), on grapefruit (*Citrus grandis* (L.) Osbeck and on corn (*Zea Mays* L.). All the aphids on these hosts were inoculated with a suspension of the spores of the fungus isolated from the eggplant aphid. The "coquí" aphid was in addition sprayed with the spores of the culture obtained from the dead aphids on this host. All the aphids except those on corn were killed by the fungus.

The results of these inoculations prove the similarity or identity of the *Cyperus rotundus* aphid fungus and the eggplant aphid *Acrostalagmus*, because the *Cyperus* aphid is killed by both fungi. The results also add aphids of two other genera and an undetermined one on four plant hosts to the list of suscepts of *A. aphidum*. The fungus has been shown to infect the aphid *Toxoptera auriantiae* Boyer on two other hosts (grapefruit and "mamey"), which the aphid may attack. (See Table I.)

The fungus did not kill the corn aphid under natural conditions. Mr. Seín, the Assistant Entomologist showed to the writer a number of corn aphids which he had kept in a culture dish and which happened to be covered with a whitish mycelium, similar to that of *A. aphidum*. A microscopic examination showed the fungus to be *A. aphidum*. Further trials were therefore made with this aphid. A small number, about 30, of insects with a few fragments of corn leaves were put in each of two large culture tubes (200 × 25 mm.) About 4 c. c. of a suspension of spores of the fungus were added to one of the tubes. The tube was kept under fair conditions of humidity by a piece of moist cotton which hung from the mouth. The mouth of the tube was stopped with a double thickness of cheese-cloth. Observations were made daily. At the end of six days all the aphids were alive in the two tubes. At the end of ten days no more corn-leaf fragments were put in the tubes. Twelve days after the experiment was started a large number of aphids had died in both tubes. It was then that the fungus mycelium was first appearing on the dead bodies of the aphids from the inoculated tube. We interpret these results as indicating that the fungus is not capable of parasitizing the corn aphid but that it may live on the dead bodies of the insect in a saprophytic manner. Had the death of the insects been brought about by the infection produced by the fungus then we would have expected some dead bodies in four to eight day, as is the case in the susceptible aphids.

The application of aphid control by *Acrostalagmus aphidum* in the field. Following our preliminary experiments in the green-house in December, 1926, field trial were effected in an effort to control the aphid ***Rhopalosipum persicae*** Sulzer on the eggplant. A plot intended for breeding purposes showed a severe infestation of the insects toward the latter part of that month. A suspension of the spores was prepared from cultures and from the dead bodies of the aphids. This was sprayed during a cool afternoon with an atomizer over the lower surfaces of the leaves where the aphids were feeding. The majority of the plants in alternate rows were treated in this manner. Only the aphids on a few of the leaves on each plant received the inoculum, as the treatment of all the leaves on each plant would have required too much labor and a considerable quantity of the spore suspension. The days following the inoculation were attended by cloudy weather with light intermittent rains. Under these conditions the fungus developed luxuriantly on the suscept insects. At the end of the first week the majority of the insects on the sprayed plants were dead. From these the inoculum was transported to the neighboring uninoculated plants and in fourteen days the infection of the insects had extended over the entire field. In less than three weeks the greater part of the aphids were parasitized by the fungus. The results were convincing. Control of the aphids in the field was possible by this simple method.

Three weeks later a short period of rains occurred. The weather was favorable for the multiplication of the aphids and therefore a new infestation came about. No longer had the aphids begun to increase in numbers than infection of their bodies with the fungus ensued. The pathogene seemed to have lived in the soil and from here the inocula was transferred to the aphids. These results showed first, that only one inoculation of the aphids is required in a field, and second, that the fungus lives in some saprophytic manner in the soil.

Eggplant has been grown in this same field during the last two years, September-December, 1927 and 1928. In both years aphids have appeared during rainy periods. However, a recurrence of the aphid fungus held them in check each year. This is a lucky circumstance since it indicates that once a field is inoculated with the fungus the latter may persist for a number of years. Our experience with the fungus covers only a period of three years and further observations should be made in succeeding years to verify its presence or disappearance.

Our field experiments have been conducted on the eggplant alone. The encouraging results in this crop should give a start to more extensive trials on other crops. From his observations the writer is convinced that an equally successful control can be secured on the aphids of the melon, cucumber, okra and other crops. On such plants like the melon, cucumber and cabbage control is probably more effective because of the foliage being closer to the soil. The inoculation experiments discused previously point to a wide range of species and genera of aphids that are parasitized by the fungus. A good many of those species are of economical importance.

Control of aphids in the greenhouse.—Eggplant and cucumber have been grown in pots during 1927 and 1928 in the greenhouse where the 1926 experiments were made. The fungus seems to have existed in the soil during all the time since our earlier experiments of 1926, for infestations of the aphids were readily stopped by its parasitizing effect. The question has been raised whether the fungus will survive in an environment where fungicides have to be systematically applied. No fungicides have been used in our greenhouse and no experiments have been planned with this point in mind, so that the question must await longer for its answer. It is only logical to expect that fungicides applied for the control of plant diseases will also hold the aphid parasite in check. Where frequent applications of sprays or fungicidal dusts are made the chances for the aphid fungus acting on its hosts will be lessened. However, it is hard to conceive that the pathogene will be eliminated from the soil unless treatments for the elimination of soil microorganisms are applied. Invasions of the aphids during the intervals between sprayings will probably be reached to some degree by the fungus.

SUMMARY

1. A fungus, *Acrostalagmus aphidum* Oud., parasitizes aphids in Porto Rico. It had been reported as *A. albus* Preuss.

2. The size of the spores in the various natural strata is more or less uniform.

3. The size of the spores appears to be larger for those produced on the natural strata than those developing on oatmeal agar cultures.

4. There seems to be a wider range of length and width of spores on our form than on the *A. aphidum* Oud. described in Saccardo's "Sylloge Fungorum".

5. Some of the conidia become one—to several—septate prior to germination.

6. Conidia or head-like structures are produced on germinating spores.

7. Some young conidia germinate while still attached to the head or to the branch tips.

8. Spores germinate rapidly in sugar solutions.

9. Spores rapidly lose their germinating power when dried.

10. Experiments indicate a possible stimulating effect of aphid juices on germination and development of spores. There are probably variations in the degree of that influence, according to species.

11. The fungus grows best at reactions of pH 6.93 to 7.93.

12. So far as is known, *Acrostalagmus aphidum* attacks the aphids on 17 species of the higher plants. Of these 8 had been reported previously and the remaining 9 are new additions. Among these are important crop plants.

13. The aphids which may be parasitized comprise five different genera of which two are here first reported. *Aphis pseudobrassicae* is first here reported parasitized by the fungus.

14. The fungus does not parasitize the corn aphid under natural conditions.

15. The fungus has also been reported on the eggplant lace-bug, *Corythaica monacha*.

16. *Acrostalagmus aphidum* can be employed successfully and cheaply in the control of the aphids of the eggplant. The method will probably be effective in field control of the aphids of other vegetables.

17. The pathogene lives in greenhouse soil. No experiment proof is at hand which would demonstrate whether the fungus is eliminated by the application of fungicides used for the control of plant diseases.

The writer wishes to express his deep gratitude to Miss Edith M. Patch, Entomologist of the Maine Agricultural Experiment Station who made the determination of some of the aphids and to Miss Vera K. Charles of the Bureau of Plant Industry, Washington, D. C., for valuable help in the specific determination of the fungus. He is also indebted to Dr. Mel. T. Cook for his suggestions and help in the preparation of the Manuscript.

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EXPLANATION OF PLATES

PLATE XI

Fig. 1. Spores of *Acrostalagmus aphidum* germinating in the juice of the Cryptostegia aphid. Drawn at the end of 6½ hours.

Fig. 2. Spores germinating in the juice of the Cyperus aphid. Drawn at the end of 6½ hours.

Fig. 3. Spores germinating in water. Drawn at the end of 6½ hours.

Fig. 4. Spores germinating in water. Drawn at the end of 15 hours.

Fig. 5. Germinating spores producing a structure similar to the appresoria of the anthracnoses. The figure on the left shows the structure has germinated with the production of a secondary spore.

Fig. 6. Spores germinating while still attached to the sporophore.

Fig. 7. A bulb or blister-like affair produced by the fungus and which behaves in germination like a spore.

Fig. 8. Formation of heads or conglutination of spores. All stages.

Fig. 9. Single spores produced at the tips of fertile hyphae.

Fig. 10. The types of branching of the fertile hyphae of *A. aphidum.*

PLATE XII

Fig. 11. The undersurface of a leaf of *Abelmoschus esculentus* showing the parasitized aphids.

Fig. 12. Portions of the leaf of fig. 11, magnified about twenty times to show the colonies of *A. aphidum* on the dead bodies of aphids.

PLATE XI.

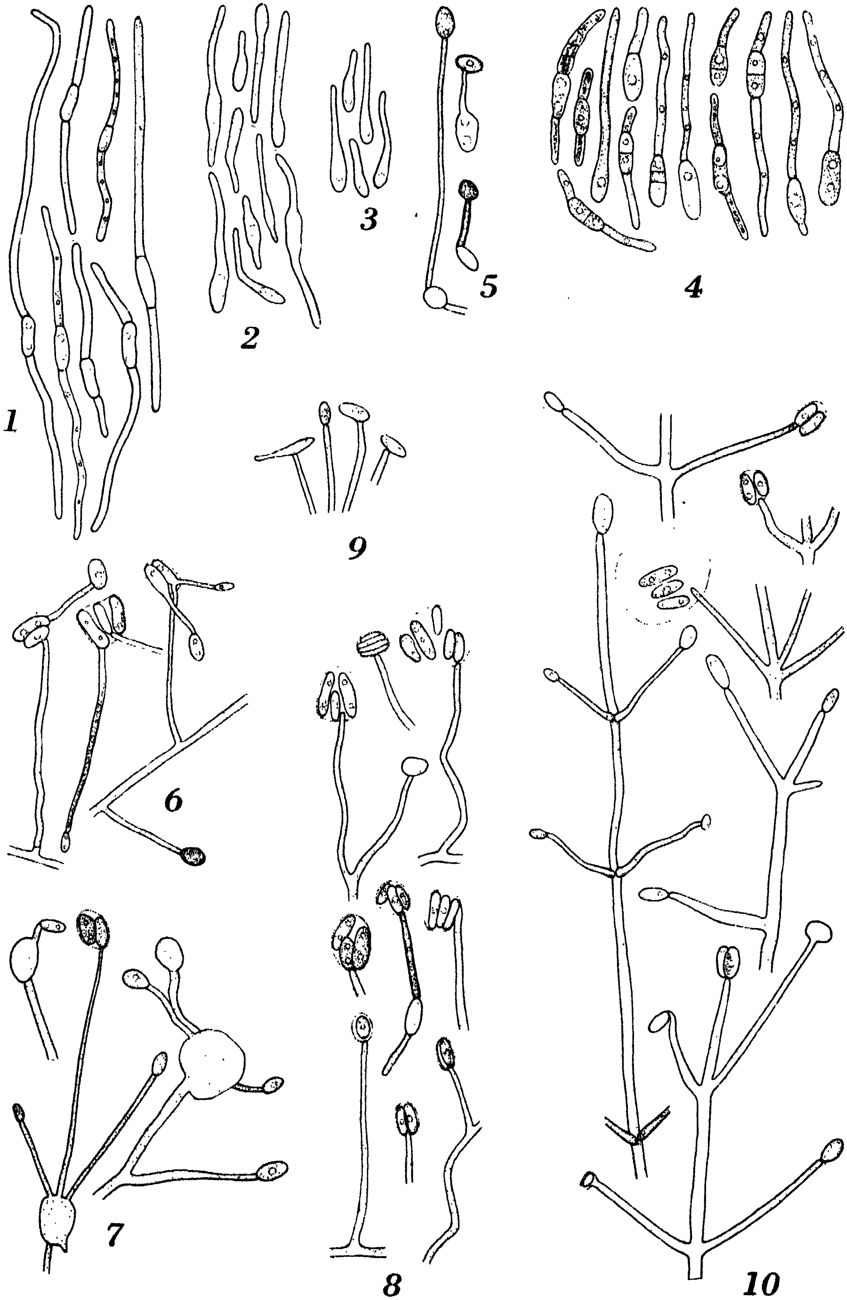
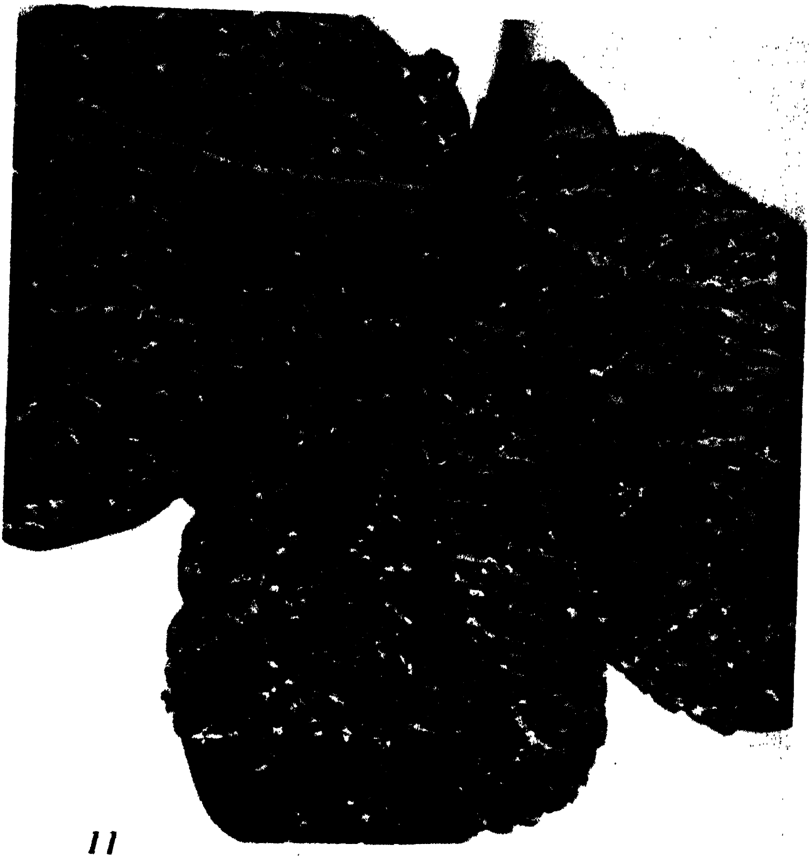


PLATE XII.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THE GUMMOSIS OF SUGAR CANE
(Second Paper)

Melville T. Cook
Plant Pathologist

The first paper on this subject by the writer was published in "The Journal of the Department of Agriculture of Porto Rico", Vol. XII, No. 3, October 1928. At that time, it was our intention to continue the work for two or possibly three years longer, to make a second test of our established varieties and to test several newly introduced and promising varieties. But when our plots were harvested on March 14th and 15th, 1929, it was found that we did not have enough diseased seed cuttings for the establishment of new plots. Therefore, it was impossible to continue the work and became necessary to publish this brief resumé of the work to date. Those who are interested in this work should read the first paper.

The conditions for the growing of this third crop (2nd ratoon) have been very unfavorable. Following the cutting of the second crop (1st ratoon) in February 1928, we had dry weather. The weather conditions and the disease caused a growth that was very much less than the cane surrounding the plots. This reduced growth must be attributed primarily to the presence of the disease. This cane was in the path of the September 13th cyclone and was severely damaged. The cane was so poor as to be scarcely worth cutting if it had not been for our desire to make records of the amount of infection. The cane surrounding these experimental plots and separated from them by a wagon road only was up to the average.

A summarization of the amount of infection is as follows:

(1) Cristalina, which was planted from diseased seed in 1925 showed an average of less than one per cent infection. Eighteen rows of 45 stools each showed no infection. Twelve rows showed slight infection. The highest infection in any row was less than 4 per cent. The infection in 1927 was 85 per cent and in 1928 varied from less than 10 per cent in some rows to 50 per cent in other rows.

(2) PR-292, PR-492 and D-433 showed less than one per cent infection. They did not show any infection in 1928 but the number of living stools had been reduced in every case.

(3). Ba-11569 showed less than one per cent infection. In 1928 this variety showed 7.1 per cent infection and a loss of 3 stools out of 45.

(4) X–62 showed about two per cent infection. In 1928 this variety showed 7.7 per cent infection and a loss of 19 stools out of 45.

(5) B–3412 showed about two per cent infection. In 1928 this variety did not show any infection but there had been a loss of 5 stools out of 45.

(6) E.K.–28 showed five per cent infection. In 1928 this variety showed 50 per cent infection.

(7) D–504 showed about 17 per cent infection. In 1928 this variety showed an infection of 12.5 per cent and a loss of 8 out of 15 stools.

(8) Otaheiti showed but one living stool out of 45 stools planted in 1925. This stool had but two canes and both were infected.

(9) B–3405, B–6032, H–109, PR–219, PR–260, PR–328, PR–487, and PR–460 showed more or less infection in 1928 but no infection in 1929.

(10) The following varieties did not show any infection on either first (1928) or second (1929) ratoon: St. Kitts, Yellow Caledonia, Badila, GC–493, FC–214, SC–12(4), BH–10(12), D–109, D–117, D–1135, B–208, B–1753, B–1809, B–3696, B–6032, B–6308, PR–67, PR–202, PR–230, PR–329, PR–333, PR–358, PR–417 and PR–729.

(11) The following varieties did not show any infection on either the plant cane (1927) or the two ratoons (1928 and 1929): D–448, PR–318, POJ–228, POJ–234, POJ–826, POJ–979, M–36 and Uba.

In 1928 small plantings of several varieties were made and the results may be summarized as follows: BSF–1248, BH–10(12), Sealey seedling, Tuc–439, B–119, B–12079, PR–422, PR–430, PR–433, PR–502, PR–503, PR–545, PR–676, POJ–36, POJ–503, PR–1228, POJ–2725 and POJ–2776 which did not show any infection. D–357 showed one per cent infection and SC–12(4) showed five per cent.

The studies on this disease in Porto Rico and elsewhere present two very interesting questions. (1) Why does the disease appear suddenly in abundance? and (2) Why is the infection greater in plant than in ratoon cane?

Two and possibly more answers may be given to the first question. (*a*) The grower may unknowingly have planted infected seed. (*b*) The disease may have been present on a property in small infections for some time. Finally the grower may have used a large amount of seed from an infected area and the conditions may have been favorable for the development of the disease. The result is a large amount of disease in the crop.

The second question may possibly be explained as follows: A large percentage of the shoots from an infected seed piece are likely to show infection which means a high percentage of infection in the crop as has been demonstrated by some of our experiments. The infection exists not only above the ground but also in the underground parts of the stems or rhizomes. In severely infected stools some of these underground parts are killed which results in a reduced tonnage in the crop. After the cutting of the first crop many of the new shoots are killed as shown in our experiments. The mortality among the small shoots is very high but shoots of five feet feet or more in height are sometimes killed. Shoots that are only slightly infected or that may escape infection entirely will survive but the tonnage of the ratoon crop is necessarily reduced in proportion to the death of the underground parts and new shoots. Since the surviving shoots are those that were healthy or only slightly infected the percentage of infection will be lower in the first ratoon than in the plant crop and lower in the second than in the first ratoon.

DISCUSSION

It appears from these studies that the planting of infected cane will give losses in first crop in proportion to the amount of infection in the seed, the relative resistance of the variety and the weather conditions during the growing season. Severely infected seed pieces may not germinate but very few such pieces will be used. Many of the new shoots from infected cuttings will die as a result of the disease which will reduce the crop. However, many slightly infected shoots will survive and the percentage of disease in the first crop or plant cane will be high.

In the production of the second crop (1st ratoon) many of the underground parts will die as a result of the disease. Many of the new shoots will die and others will be weak for lack of necessary plant food. The percentage of young shoots which die during the second year appears to be greater than during the first year. Therefore, the percentage of living infected shoots at cutting time is less than when the first crop is cut but the tonnage is also reduced as a result of the death of so many shoots.

Likewise the third crop (2nd ratoon), for the same reasons will show a still lower percentage of infection and a still lower tonnage. Of course both the percentage of infection and the amount of the tonnage may vary to some extent with the soil and weather conditions.

Under present conditions in Porto Rico, our two favorite canes, BH-10(12) and SC-12(4) can be grown with very little fear of losses from gummosis, but the grower should never use seed cuttings from an infected field.

High producing susceptible varieties of sugar cane can be grown in territory where the disease is not present but in case the disease appears in these localities the growers should replant the infected fields with highly resistant varieties. The POJ canes which we have tested in Porto Rico appear to be immune to the disease.

The abandoning of the old favorites such as Cristalina, Rayada, Otaheiti and Yellow Caledonia, the increased planting of BH-10(12), SC-12(4), Uba and the POJs, leads the writer to believe that the gummosis disease is a diminishing factor in Porto Rico. However, any disease is a menace to the crop on which it exists, because a change in conditions may enable it to become a dangerous factor. So long as this disease exists on the island, it will be a dangerous factor in the development of or introduction of a new desirable but susceptible variety.

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NOTES ON PORTO RICAN HOMOPTERA

By

HERBERT OSBORN

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VOL. XIII JULY 1929 No. 3

NOTES ON PORTO RICAN HOMOPTERA

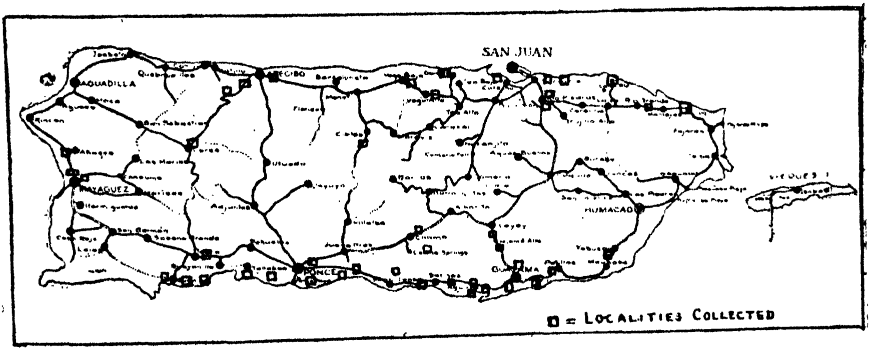
HERBERT OSBORN

INTRODUCTION

The following notes are based mainly on collections made during a brief visit to Porto Rico during the winter of 1928–1929. Previous records in the group have been made by VanDine, Smyth, Wolcott, Muir, Dozier and others, but all up to 1923 have been enumerated in Wolcott's INSECTAE PORTORICENSIS (**13**).

The larger part of my time from January 7 to March 20 was spent on the south side of the Island at Aguirre where my son, Herbert T. Osborn is located and where I had the advantage of assistance and courtesies from officers of the Aguirre Sugar Co. From February 5th to 14th was given to the north side where I had the kind cooperation of the Insular Department of Agriculture and the Insular Experiment Station, enabling me to visit many localities along the north shore and some of those of the interior.

While the abundance of the Homoptera had very evidently been greatly reduced by the severe hurricane of September 13, 1928 I was able to secure specimens from many points and to add a number of species to the known fauna of the island and some species which appear to be new to science.



Map of Porto Rico showing localities where collections were made in 1929.

It was impracticable to make trips to the higher mountain peaks but collections were made at various elevations up to above 2,000 feet. The larger number however were taken at near sea level and in regions largely under cultivation. Collections from the various important crop plants, sugar cane, coffee, tobacco, sweet potatoes, beans, etc., were made as fully as practicable. Collections on strictly native plants were confined largely to the beaches, *playas*, salt flats and former marsh lands adjacent to the coast and still occupied by a considerable element of the endemic flora.

Frequent rains especially when in the mountains, and high winds on almost every day in the field interfered to some degree with rapid work although the winds undoubtedly offset the burden of tropical sun and the attacks of mosquitoes and gnats which must be endured in the habitats most promising for interesting captures.

Frequent use was made of the valuable INSECTAE PORTORICENSIS by Wolcott (**13**) and the ECOLOGICAL SURVEY OF THE FLORA OF PORTO RICO by Cook and Gleason (**1**), the former as a guide to the known fauna and the latter especially for location of desirable collecting grounds and recognition of unfamiliar plants.

I wish to express my obligation to the Commissioner of Agriculture, Dr. Carlos E. Chardon, to Director R. Fernández-García of the Insular Experiment Station, Dr. Mel. T. Cook and Mr. Francisco Seín for generous assistance in visiting a number of localities on the north side of the island, and to the officers of the Aguirre and Guánica Sugar companies for many courtesies, while the help of my son, Herbert T. Osborn was of great service in finding suitable collecting localities in the southern part.

To Dr. N. L. Britton of the New York Botanical Garden, who was spending the winter on the island, I am indebted for a pleasurable collecting trip to Sabana Abaca and for the identification of a number of plants on which Homoptera were captured.

I am also indebted to the Graduate Council of the Ohio State University for a grant from their research fund to assist in the expenses incurred in securing the collections. The specimens collected, including the types of the species described as new, are included in the author's collections deposited at the Ohio State University.

SCOPE OF SURVEY

It has been my object to secure as full a representation as possible, in the time available, of the Homoptera occurring on the island as a basis for comparison with the fauna of other islands or mainland regions and to show when possible the relation of the Porto Rico Homopterous fauna to that of other lands. Also to secure such data as might form a basis for some judgment as to the economic importance to the crops of the island and the ecologic relation to habitat and food plants.

For those unfamiliar with the island and as a general foundation for comment it may be stated that Porto Rico lies within the tropics from 17° 15′ to 18° 15′ north latitude, is about 110 miles long from east to west and 40 miles wide north to south; that there are a number of mountain ranges occupying most of the island, separated by fertile valleys and with a coastal fringe of 5 to 10 or 15 miles. The land is largely under cultivation even up to the tops of many of the hills and lower mountains and consequently the areas of endemic vegetation are very much reduced. The prevailing wind is east to west and of almost constant occurrence with velocity running up nearly to gales. Rains are of almost daily occurrence in the mountains and frequent in the north part of the island but less frequent in the south part. A part of the south-west section is almost arid, the rain being almost totally absent in the dry season and infrequent during the entire year. It is quite to be expected, therefore, that there should be considerable variety in the vegetation of different localities and necessarily much variety in character of insect life.

SOURCES OF HOMOPTEROUS FAUNA

If we compare the homopterous fauna of Porto Rico with that of Santo Domingo, Jamaica or Cuba we are struck with the much smaller number of species and the question naturally arises as to the explanation for such a paucity.

Wolcott (**13**) lists 39 Cicadellidæ and 33 other species of Homoptera (total 72) for Porto Rico, which includes the records made at the Insular Experiment Station through a number of years as well as such scattering records as have appeared in the numerous papers on Porto Rican insects up to the date of his publication (1923). While such collections were mostly made by persons not specialists in Homoptera still they must represent fairly well the occurrence of all but the rarer forms.

VanDuzee (**11**) has enumerated 102 species taken in Jamaica during a rather brief collecting trip on that island and the list would doubtless be increased if all recorded species were added. Osborn (**7**) listed 180 species in Cuba from collections made in February and March with additions of other records for that island. There is no detailed list for Santo Domingo and Haiti so far as I have noted but in view of the scattered records from that island I am confident the numbers must far exceed those known to Porto Rico.

Some of the more striking occurrences for all the greater Antilles are *Agallia albidula, Cicadella similis* and *C. sirena, Kolla fasciata; Draeculacephala sagittifera; Xerophloea viridis; Spagbergiella vulnerata, Scaphoideus, fasciatus; Deltocephalus flavicosta, D. sonorus* and *D. balli? Euselis obscurinervis; Acinopterus angulatus* (*acuminatus auct.*) *Thamnotettix colonus, F. comatus and T. nigrifrons, Cicadula 6-notata. Eugnathodus abdominalis, Protalebra braziliensis* and *P. similis;* all of these having a very wide distribution in the neotropics and many of them occurring as far north as in the gulf states and some of them even in the northern states or Canada.

The species common to Porto Rico and South America are *Agallia sticticollis, Cicadella similis, Deltocephalus flavicosta, Euscelis obscurinervis, Thamnotettix colonus* and *T. comatus, Protalebra braziliensis, Empoasca fabae* and *E. flavescens.* Of the immense number of Cicadellinæ, many hundreds of species, and the great aggregations of species in the Cicadidæ, Membracidæ Cercopidæ and Fulgoridæ in South America, Porto Rico has almost none if we except the Delphacidæ which are represented by a number of species and some of these by hosts of individuals.

The species common to Porto Rico and Central America are with others *Cicadella similis; Kolla fasciata; Draeculacephala sagittiffera; Xeropholea viridis; Spangbergiella vulnerata; Scaphoideus fasciatus; Deltocephalus flavicosta; Euscelis obscurinervis; Thamnotettix colonus, T. comatus, T. nigrifrons; Eugnathodus abdominalis; Dikraneura marginella; Protalebra similis, T. braziliensis; Empoasca fabae, E. flavescens.*

It seems in general that there are fewer species common to South America than to Central America and many less than to other islands of the Greater Antilles or even to Florida.

Of the species common throughout the tropics most could have been distributed by human agencies as they occur on cultivated crops or grasses used for pasturage; as Para, St. Augustine, Bermuda, and Guinea grasses. Scarcely any of the endemic species seem to have any indication of original derivation from South America.

It may be noted that the principal winds and particularly the tropical storms—hurricanes—as well as regular trade winds travel from east to west and from south east to northwest and so far as wind agency is concerned and probably surface currents with drift on the water, the direction of dispersal would be from east to west. That is, Porto Rican insects might conceivably be carried to Santo

Domingo or other islands to the west but there would be much less probability of a return distribution. Porto Rico as related to the great expanse of the ocean is but a dot on the map and the chances of an insect reaching the island by natural agencies in such numbers as to stand a chance of establishment would seem to be quite remote.

Another phase of wind agency may be the possible depletion or even extinction of rarer species in Porto Rico by the devastating hurricanes which sweep the island and strip the vegetation of bloom, leaves and even twigs or branches while larger trees may be felled and killed. Such destruction must sweep away or destroy insects dependent upon particular host plants. Such storms have swept practically the whole island several times and such a one as occurred on September 13 last (1928) must have a tremendous effect on the leaf hopper fauna especially those species living on trees and shrubs. Those living on grasses or low herbage probably have a better chance of survival, or for some percentage of the population at least to survive, although I am told that large areas of grass land were so damaged by the last hurricane as to appear as if ravaged by fire.

Another factor to be noted is the immense change in the plant life of the island due to the intensive cultivation since occupation by man. It is well known that Porto Rico is one of the most densely populated areas of the world. It is probably less generally appreciated that this has resulted in the destruction of the native flora and as pointed out by Cook and Gleason (**1**) a very complete substitution of cultivated plants or a reoccupation by plants of foreign derivation. It is stated that only on the highest parts of the higher mountains is there what can be called an approach to the primitive conditions for the plant life. Practically all of the mountains have been denuded of the primitive forest and very many of them planted with crops of coffee, tobacco, bananas and other minor field or garden species and even sugar-cane fields are in some places carried well up on the hillsides.

It may seem rash to draw conclusions from records that are manifestly fragmentary, but collections in Porto Rico have been more extended and cover a longer period of time than for any other island of the group and while few of the collectors have been specialists in Homoptera a number have given sufficient attention to the group so that collections must be considered as fairly representative for the more common species at least. Moreover in my own collecting I have been able to secure examples of practically every species catalogued by Wolcott and in addition have added only 43 species of which seven appear to have been previously undescribed.

If, then, we are warranted in venturing any conclusion, it would be that in the long period of isolation represented in the history of the island, variously estimated as running back to Tertiary or Cretaceous time, there has been accession both by immigration and by evolution or modification a rather meager homopterous fauna; that the accessions by immigration include species mainly now common to the whole neotropic realm and that many have been brought in by the introduction of crop plants, possibly as long ago as during the migration of the aboriginal Caribs; that species developing on the island have been transported to adjacent islands and that there has been rather unusual opportunity for the elimination of species dependent upon the foliage of particular trees and shrubs.

Even where the endemic flora has survived as on some of the most inaccessible or infertile of the mountain peaks or in the gorges of some of the most precipitous mountain valleys the remnants of isolated plants offer poor opportunity for the perpetuation of fragile insects exposed to torrential rains and devastating wind storms. We have also to take account of the host of predators, lizards, birds, spiders and predatory or parasitic insects as well as presumptive fungous diseases as factors in the reduction or elimination of these insects. Altogether the Homoptera, especially leafhoppers in Porto Rico, have had a precarious and stormy life and the existing species represent stock which by rapid multiplication or adaptation to specially favored locations or special host plants have been able to maintain existence. Even those species of wide distribution occurring on cultivated plants appear to be kept within moderate numbers as compared with other regions and their economic importance therefore modified. Possibly at the time of my visit the abundance of the pasture and grass-feeding species had been much reduced by the recent hurricane but I nowhere found such swarms of leafhoppers as may often he observed in the States or in other tropical localities.

It is manifest that it is a hopeless task to determine certainly the point of origin and the paths of dispersal or the means of transportation for the numerous species now scattered thoughout the tropical parts of the western hemisphere. However alluring the problem as a speculation, its futility is too evident to warrant such discussion here. With the many changes in land connection and elevations or depressions which have changed the vegetation we can be assured that there has been extensive adaptations, migrations and extinctions in the history of such an island as Porto Rico.

HOST PLANTS

The Homoptera are essentially plant feeding insects and necessarily associated with such vegetation as may furnish suitable food supply. Many species are restricted to particular host species, others to certain groups of plant hosts, while a few seem to have the ability to live on a great variety of plants. In the main certain genera have limitations to certain genera or groups of plants as the species of *Deltocephalus*, *Euscelis*, *Cicadula* and *Eugnathodus* to plants of the grass family and most of the Typhlocybinæ to woody plants. It follows that the local distribution of species is mainly dependent upon the distribution of the flora and the ecological associations are almost entirely determined by the plant distribution.

ECOLOGICAL ASSOCIATIONS

I shall not attempt to discuss the various ecological associations of the island as a whole as my observations have been too limited to warrant such a discussion. However, there are some of the associations which I have studied that are so well marked that a brief discussion is in place especially as this will include mention of the relation of some of the cultivated crops of importance on the island.

Among the primitive groupings within which I have worked are the coastal complexes both of the beach and tidal flats or *playas* and while many of the Homoptera occurring here are by no means limited to such association there are some forms that are very distinctly restricted to the vegetation characteristic of this habitat.

On the sandy dunes which support a sparse growth of sea grape (*Coccolobis*) with associated plants will be found the common *Bothriocera venosa*, *Ormenis pymaea* and *O. marginata*, while the grasses and sedges will yield occasional specimens of *Deltocephalus trilobatus*, *D. maculellus* and *D. albovenosa*; *Chlorotettix minimus* and *C. tethys* and *Typhlocybella minima*.

The mangrove association seems quite free from Homoptera here although in Panama I have taken some peculiar species, but associated sedges, and especially the *Sesuvium* complex furnish some interesting species. A creeping succulent plant *Sesuvium portulacastrum* at Aguirre was found to be swarming with *Cicadella sirena* including many nymphs of various stages so that it must be counted a distinct host plant although the species is found on many different plants even up to high altitudes, 1,000 to 2,000 feet. Also a remarkable rose-colored *Thamnotettix* (*T. rubicundula*) and several species of Fulgorids including *Oliarus franciscanus* and two or three species of Delphacids.

On the sedge *Fimbristylis spadicea* I took a peculiar highly colored species of *Eugnathodus* (*E. rosaceus* n. sp.) which so far as collections indicate is limited to this particular association though possibly occurring also on the associated *Cyperus laevigatus*. On the beach grass *Sporobolus virginicus* a few specimens of the wide-spread grass feeding *Euscelis obscurinervis* and some Delphacids.

In the forest association it has been more difficult to segregate species due to the intermingling of species and the limited opportunity to collect from isolated trees. The native *Cordia* is host to a striking species of Protalebra (*P. cordiae* n. sp.)

The native grasses occurring on the hillsides were very sparsely populated with leafhoppers, possibly due to close cropping by cattle or goats or as a result of the hurricane and torrential rains of the September storm. *Deltocephalus trilobatus* taken on a hillside above Salinas at an elevation of 1,200 to 1,500 feet is the principal member in this association but the universally distributed grass-feeding *Deltocephalus flavicosta* is a frequent associate, and *Chlorotettix minimus* and *C. tethys* are occasional members.

Leaf Hoppers and Sugar Cane

As sugar cane is the most important cultivated crop in Porto Rico the leafhoppers associated with it are of special interest and I have given considerable time to observations in the cane-fields with the leafhopper population in mind. In many sugar-cane regions certain species of leafhoppers have proven of great importance, sometimes causing extensive losses but it may be stated that in general and especially for the season of my observation they may be counted as negligible, from the economic standpoint, in Porto Rico. However if the present species are comparatively innoxious it is of special importance to prevent the introduction of any of the species that have been destructive in other countries and it is evident that one of the most important phases of inspection and quarantine should be to know the possible menacing forms, their methods of transfer and best means of preventing their introduction.

I have elsewhere called attention to the importance of leafhoppers * from the standpoint of insect introductions and emphasized the desirability of extended surveys and studies of the tropical species with particular attention to their host plants and means of dispersal with reference to the southern states or to green-house crops in the north. It is certainly of equal, perhaps greater, importance in a tropical island such as Porto Rico which has so far escaped the introduction of many of the abundant and destructive species of South or Central America. With expanding commerce between the West Indies and the main land of South America and the isthmian region and the shortening of time by faster steamers or airplane communication there is an increasing probability of transfers of insects or insect eggs and it will certainly be the part of wisdom to maintain vigilant inspection of plant introduction and to use all possible means to secure knowledge of menacing species and their habits.

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* Jour. Econ. Entom., Vol. 22, p. 1929.

The common "Froghopper" of Trinidad which has been noted as a serious pest in sugar cane is a fair case in point as there would seem to be no reason to expect anything but rapid multiplication and serious damage in Porto Rico if this species should chance to be introduced and get a foothold in the island.

It is well known that species of little importance in their native habitat may assume major importance when brought into a region where they have abundant food and are released from the natural enemies of their home. The cane leafhopper which caused such havoc in Hawaii, and which very fortunately seems never to have been brought to the West Indies was brought under control by the use of native parasites from Australia but if it should secure a foothold in Porto Rico or any of the West Indian islands we could have no guarantee that the same parasites would be equally effective in its control as we cannot assume the same conditions of environment. Once the pest became established as a member of the local fauna no one could predict when or how often it might multiply in destructive numbers.

SYSTEMATIC AND FAUNISTIC NOTES

CICADIDÆ

No cicadas were collected during my stay in Porto Rico, probably because the species occur mainly at other times of the year, although Davis remarks that "It appears likely that a cicada may be taken in Porto Rico on any day of the year." Wolcott (**13**) lists two species, and Davis in a later paper (**2**) discusses these two species, one constituting a new genus and species. He remarks that since Haiti has six species known to him it may be that those for Porto Rico will be doubled in number. However, this discrepancy in number seems to agree with that in other groups and there is again a very marked difference in number of species as compared with South America, where the family is very rich in species.

Proarna hilaris Germar.

This appears to be the most abundant form as numerous records are given by Wolcott and a number of additional ones by Davis. Davis says it seems to be most common from October to May.

Borencona aguadilla Davis.

Davis records the types from Yauco, and lists a number of other localities including those by Wolcott under *Zammara* sp.

Evidently further study is needed to determine exactly the cicadan fauna for the island but considering the large size and conspicuous character of these insects it is doubtful whether many more species will be found. Neither of the species known seem to be abundant enough to merit economic consideration.

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(1) Insecta Portoricensis, Jour. Dep. Agr. of Porto Rico, Vol. 7, p. 256, 1923.

(2) The Cicadas of Porto Rico with a description of a new genus and species. Jour. N. Y. Ent. Soc., Vol. 34, p. 29–33, 1928.

MEMBRACIDÆ

Wolcott lists two species in this family, neither of which appeared in my collecting, probably on account of the season of the year or possibly from the absence of plants from which I had the opportunity to collect.

Antianthe expansa Germar.

Recorded by Wolcott for a number of host plants in localities scattered over the island.

Monobelus fasciatus Fabricius.

Wolcott records it on coffee and on several other host plants.

Nessorhinus vulpes A. & S.

This species was taken at Lares on shrubs or low trees and a specimen in the National Museum is recorded as from Mayagüez with determination by Funkhouser.

CERCOPIDÆ

No members of this family were secured in my collecting during the winter and Wolcott records only two species.

Epicranion championi Fowler.

Listed for coffee and for *Inga laurina* which is used as a shade for coffee. The record would indicate that this species would be of economic importance in coffee plantations.

Philaenus fusco-varius Stal.

Mentioned by Wolcott as occurring on weeds and on mulberry.

BYTHOSCOPIDÆ

Agallia pepino DeLong & Wolcott.

This handsome little species was taken somewhat commonly in sweeping vegetation along roadside near Cayey Jan. 28, at an elevation of 2,000 to 2,100 feet and near Yabucoa Jan. 29, also at Río Piedras Feb. 8 and 14 and at Ciales Feb. 9.

Wolcott took it from carpet grass *Axonopus compressus* at Ciales and on sugar cane at San Sebastián. I took it at Ermita in Cuba Feb. 1925 and the species probably occurs in Santo Domingo and Haiti.

Agallia pulchra DeLong & Wolcott.

One specimen of this handsome species from roadside vegetation near Cayey. Jan. 28 and others March 16, 2,100 feet elevation, one on vegetation on cliff, Lares, Feb. 12, altitude 1,200 to 1,300 feet. The experiment station collection contains four specimens, two male and two female, not seen by DeLong. One only with bright orange on pronotum, others with the yellowish disk and black central line in front and two black dashes behind the eye. One male, with the dark patch on disk. Male plates slender, tapered; female segment truncate, incised at middle. Black on claval veins broken; tips of clavus yellow.

Agallia sticticollis Stal. (*A carrotovora* De Long & Wolcott.)

Taken at San Juan on Sweet Potato Feb. 8. Recorded as from carrots by Wolcott (1923). The DeLong type and the specimens I collected appear to be identical with specimens from Brazil which I have identified as *A. sticticollis* Stal. This gives it a wide range and furnishes an instance of the occurrence of a South American species in Porto Rico.

Agallia albidula Uhler (*A. tenella* Ball.?)

Common on *Amaranth* sp. near Salinas in cane field. An abundant species throughout the island and in the Lesser Antilles, Cuba and doubtless in San Domingo and Haiti. Many localities. Guayama Jan. 14, Cayey Jan. 24, Yabucoa Jan. 29, Sabana Abaca Feb. 5, (*Hyptis* association) Arecibo Feb. 13.

CICADELLIDÆ

Cicadella similis Walker.

This species is very widely distributed throughout the West Indies and parts of South America, Central and subtropical North America and seems to be everywhere present in Porto Rico, occurring on a great variety of plants especially the "malojillo" grass (*Panicum barbinode*). It occurs occasionally on sugar cane and Wolcott records nymphs and eggs as well as adults but in my own collecting I have taken only adults and it seems probable that occurrences of eggs and nymphs are exceptional and that the migrations to cane result from the clearing out or ripening of the grass plants which have served as their hosts. It is seldom abundant on Guinea grass as compared with the "malojillo" but on some of the pasture grasses it must really be destructive and to be counted of economic importance. Wolcott's (13) records for grape fruit, coffee and some other plants, not of the grass family are probably based on captures of adults occurring only temporarily or accidentally on these plants although in my own collecting they have been taken in many unexpected places. Nymphs are taken in January and there is probably more or less of overlapping of life history throughout the year and considerable migration of adults determined by the succulence of available food plants. I have found it under very similar conditions in Mexico, Cuba, and the Canal Zone and other places.

The species has received considerable attention from entomologists. Smyth having used it in experiments with transmission of mosaic and Wolcott treating its life history and economic status. Further the records of its occurrence in different countries extend back for many years at least to the middle of the last century.

Cicadella coffeaphila Dozier.

Dr. Dozier describes this species as occurring on coffee and remarks that it was abundant at many points. No trace of the species was found on any of the coffee trees I examined and considering the almost complete defoliation of trees in all the plantations I visited I should think there would have been little chance for survival of these insects.

This and *C. coffeacola* were included under *C. occatoria* in Wolcott's paper but Dozier (4) points out the differences.

Cicadella coffeacola Dozier.

This species like the preceding was described as occurring on coffee and Dozier mentions its abundance in many coffee-growing localities. No specimens were found in any of the plantations visited although I made a special effort to collect from coffee trees.

Cicadella sirena Stal.

Wolcott lists this species as occurring on a large variety of plants including grasses, garden vegetables, grape fruit, weeds and sugar cane. I took it at nearly all points where collecting was done and upon a considerable variety of host plants at different elevations. At Aguirre it occurred in all stages on *Sesuvium* in the salt flats so that there can be no question that this plant serves at times as a perfect host plant for the species. It was also taken near Ponce from *Barita* which may also serve as a host plant although it was found on this plant on but one occasion. Other localities are Sabana Abaca Feb. 5, Arecibo Feb. 13, Salinas Jan. 21. When occurring on garden crops and other cultivated plants of economic value it must be counted injurious.

Kolla fasciata Walker.

This is another neotropical species of very wide distribution in tropical and subtropical America. It is a common species in Porto Rico and has been taken at most of the localities where I have collected. Guayama, Aguirre, Salinas, Guánica, Yabucoa, Río Piedras, Lares, Ciales, Arecibo, Vega Alta and other points throughout the time of my visit. It occurs on a number of different species of grass and may be swept from mixed vegetation of great variety although probably its natural food plants are in the grass family. It is often in such abundance that it must be counted of economic importance. Wolcott (13) records it for the "St. Augustine, Bermuda and Carpet grass, on sugar cane and malojillo." I have taken it commonly in sweeping mixed grasses and weeds especially on hillsides.

Draeculacephala sagittifera Uhler.

This species may be expected to occur at every point where Bermuda grass is present as this seems to be its favorite host. Adults are abundant and active throughout the winter. While the grass does not appear to show great evidence of the work of the insect there can be no doubt that where these insects occur by the millions, as is often the case, there must be a heavy drain on the plants and a corresponding loss in forage value to the live stock pastured on the infested fields. Wolcott gives a record for sugar cane but this can hardly be counted a normal host.

Xerophloea viridis Fabricius.

This species occurs from Southern South America to Northern

United States and often in great abundance. Only scattering specimens have been taken this season and I think it must have been reduced in numbers by the storm. Records for Guayama Jan. 12, Aguirre Jan. 17, Guánica on grass Jan. 18, on *Barita* near Ponce March 2. Wolcott records it as common on carrots but it is generally found on grasses and probably breeds mainly, if not entirely, on species of the grass family.

Xestocephalus pulicarius Van Duzee.

This widely distributed species, included in Wolcotts catalogue, was taken in small numbers at Aguirre, Feb. 12, Sabana Abaca, Feb. 5, Guayama, Feb. 7, Río Piedras, Feb. 8, Lares, Feb. 12, Cayey Road, 2,000 ft. elevation, Mar. 16.

Xestocephalus maculatus n. sp.

Head small; vertex broad half longer at middle than next the eye, front convex, polished. Pronotum longer than vertex widening posteriorly. Elytra narrowing to apex. Female last ventral segment slightly notched; pygofer with dense setæ. Male valve hidden; plates elongate, triangular, densely setose.

Dark brown with numerous black or fuscous maculations. Costa of elytra beyond basal third with alternating squarish tesselations, black and whitish or subhyaline and about ten conspicuous white lots on each elytron and two small elongate spots on apical ends of claval veins; veins of apical half blackish.

Length 3.25 mm.

Described from a series of specimens (type female, allotype male, and paratypes) collected on the Cayey Road, Jan. 28 and Mar. 16, at about 2,000 ft. elevation. most of them from *Inga* trees, which appear to be normal host plants. It is the size and form of *X. tesselatus* but much darker and the picture quite different.

Spangbergiella vulnerata Uhler.

This species was taken at several different points but in small numbers and usually upon Guinea grass which appears to be a common food plant. Specimens were secured at Aguirre from Guinea grass pasture and there are records for San Juan, Río Piedras and there are specimens from Vieques in the Experiment Station. Wolcott's records include one from "Sugar cane and malojillo grass".

Scaphoideus fasciatus Osborn.

Specimens of this species were taken at a number of different points, always in grass land and in connection with Guinea grass but not restricted to this one species. Guayama, Jan. 12, Aguirre, Jan. 17, Feb. 2, and Añasco, March 1, Sabana Abaca and beach near San Juan, Feb. 5.

This species, while fairly common is not sufficiently abundant to be counted of economic importance judged by collection made during the winter. The numbers may have been reduced as the result of the storms or of dry weather.

Scaphoideus bimarginatus DeLong.

This was described by DeLong (1923) from one female collected at light at Pt. Cangrejos, Feb. 27, 1920, by Wolcott, but no other Porto Rican specimens have been noted. I collected it from Cuban pines at Herradura, Cuba in March, 1925, and also at Ermita without host record. If the species is restricted to West Indian pine it may be looked for at intervening points from Porto Rico to Cuba.

Platymetopius loricatus Van Duzee.

Two specimens of this species were secured at Aguirre, Feb. 18, in sweeping mixed vegetation on waste land at sea level. The species is common over the southern United States and in Central America. The Porto Rican specimens agree perfectly with those from Guatemala in my collection. This is probably the species given as "*Platymelopius* sp" "on string beans" in Wolcott's list.

Deltocephalus trilobatus DeLong.

A number of specimens of this well marked species were swept from a native grass on the rocky mountain side in Salinas valley at some 1,500 to 1,800 ft. elevation. The grass was scant but pastured and in places close cropped and the leaf hoppers evidently rare as they were secured only by persistant sweeping and then in but small numbers. The markings agree with DeLong's description but the triangular spots at anterior angle of vertex are brown rather than orange. There are conspicuous fuscous blotches in a discal cell and in first and second apical areoles.

The species has been taken also at lower elevations, but in very small numbers and can have little economic importance. Arecibo, Beach at Sabana Abaca, and Aguirre.

Deltocephalus sonorus Ball.

Taken at Central Aguirre on grass. This species has been recorded for a wide range of territory having been described from specimens taken in South Western United States and common in the Gulf states and Cuba. Wolcott records it "On malojillo grass at Pt. Cangrejos". I have found it only in small numbers and it can have little economic importance here unless there are times when it becomes much more abundant. It probably occurs on several different kinds of grass.

Deltocephalus maculellus Osborn.

Specimens of this species which was described originally from the eastern part of Cuba were taken at Guayama, Jan. 12, Coamo, Jan. 13, and Fortuna, March 15. They agree perfectly with the type specimens and it is probable the species will be found in Santo Domingo and Haiti. The species of grass is not known.

Deltocephalus albovenosus Osborn.

This species was described from Cuba and specimens were taken in Porto Rico at San Juan, Feb. 10, Luquillo, Feb. 11 and Añasco, March 1. All these localities are at or near sea level and specimens were from beach grass or similar association.

Deltocephalus nigripennis DeLong.

DeLong described this species from "one male swept from grass at Boquerón". I have not taken any specimens that answer his description or agree with his type but the species is evidently quite closely related to one I described as *D. flaveolus* from Cuba, differing in the picture of elytra.

Deltocephalus flavicosta Stal.

This species is very widely distributed in Tropical America and north to the Great Lakes in the United States. It has been taken in Porto Rico at practically all points where I collected and from sweepings on grasses of diffierent kinds. While not particularly abundant during the season it evidently succeeded in establishing itself generally after the storms and may be expected to increase in favorable locations. It is one of the common species in pasture lands, occurs upon Guinea grass and is one of the species that seems well established on this pasture grass and it was taken at Mayagüez on Guatemala grass. It shows considerable variation in the intensity of coloration and the typical dark form merges into lighter varieties. It may be counted distinctly an economic species but if not more abundant than during the past winter cannot be counted a serious pest.

Euscelis obscurinervis Stal (=exitiosa Uhl.)

This common and very abundant species throughout the tropics has an extension in the United States to its northern border and is common on a great number of grasses, but in the tropical regions or within the range of distribution of Bermuda grass seems to be particularly plentiful on this species. In Porto Rico it was taken everywhere that suitable grasses were available and in some localities, in considerable numbers. Nymphs were found during most of the season and at practically all localities. It is of distinct economic importance on forage grasses except perhaps for Guinea grass where I did not find it present in any numbers.

Euscelis striola Fall.

Recorded by Wolcott but not taken in any of my collections.

Acinopterus angulatus Lawson.

Specimens collected in Porto Rico agree closely with paratype material in my collection used by Dr. Lawson. The West Indian specimens generally according to Dr. Lawson will fall under this name.

Guayama, Jan. 12, Aguirre, Jan. 18, Sabana Abaca, Feb. 5, Salinas, Mar. 12.

Thamnotettix colonus Uhler.

This is an abundant species throughout the West Indies and the coastal states of the United States, and also in Central and South America. Its range may be considered as covering the entire neotropic region and the sub-tropical part of the United States. It occurs on Bermuda and St. Augustine grass and apparently its range coincides pretty closely with the distribution of these grasses although it does not seem to be particularly confined to them as food plants. It was taken in Porto Rico in all localities where these grasses occur. Guayama, Jan. 12, on the Cayey Road at elevations of about 2,000 ft. on Jan. 28, at Yabucoa, Jan. 29, Patillas, Jan. 25, San Juan, Feb. 5, Río Piedras, Feb. 8 and 14, Vega Alta, Feb. 6, Cataño, Feb. 7, Ciales, Feb. 9, Lares, Feb. 12, Arecibo, Feb. 13, and Aguirre, Jan. and Feb. The species would be of considerable economic importance if the host plants were used extensively for forage. It did not appear in the Guinea grass pastures and consequently does not seem to be of consequence in the principal pasture areas of the island.

Thamnotettix cubana Osborn.

This species was described from Cuba and has been taken most commonly on Guinea grass but sometimes in mixed areas of grass land. Records for Porto Rico including Guayama, Jan. 12, Aguirre, Jan. So far as present season observations go, the species does not appear to be abundant enough to have special economic importance.

Thamnotettix nigrifrons Forbes.

This species is very common throughout the West Indies and United States and has been recognized as an important economic species affecting grasses and also at times attacking small grain crops. The Porto Rican specimens are quite pale, the face with rather faint black bars but the venation and other structural characters agree closely with typical forms for the United States. Specimens were taken at a number of localities, especially at Santa Rita, Luquillo and Loíza (Old).

Thamnotettix comatus Ball.

The record in Wolcott's catalogue for specimens occurring on carrots appears to be based on specimens which agree with *T. cubanus*. Specimens collected at Río Piedras agree very well with what I have as *T. comatus* from Central and South America, including specimens from the type material from Orizabo, Mexico, used by Dr. Ball, and on these I have based the record of the species for Porto Rico.

Thamnotettix rubicundula Van Duzee.

Head subangulate, wider than pronotum: vertex longer at middle than at eye. Pronotum longer than vertex. Elytra with conspicuous venation. Female last ventral segment about twice as long as preceding, slightly concave, deeply and rather broadly incised at middle half way to base, incision bordered with dusky or black, with crescentric sub margin at inner end—pygofer borders in some cases darkened. Male valve broad, as long as preceding segment broadly rounded behind, plates short, almost truncate, hind margin with short spines or hairs about equalling pygofer in length; styles exposed and black tipped.

Color uniformly rosy, fading to yellowish both above and below; the elytra subhyaline but suffused with rose color. The veins conspicuously red and, especially in males, a slight tendency to smoky on the apical part; legs a little paler and the tibial spines more or less blackish.

Length female 3.5 male 3.25 mm.

Described from a large series of both sexes. Collected on *Sesuvium portulacastrum* at Aguirre, Feb. 20 and at Coquí, Feb. 22 and Ensenada, March 11. This is evidently the restricted host plant as the species has not been taken from any other plant and nymphs of all stages or sizes have been taken with the adult.

The nymphs of different instars are like the adults and the color agrees with the abundant reddish patches of the host plant which occur in extensive mats often with no other form of plant on the salt flat adjacent to the sea shore.

VanDuzee described his *T. rubicundula* from a single female collected in Jamaica with no indication of food plant and I know of no further record of the species. I had considered the species undescribed and prepared the above diagnosis but careful comparison with the Van Duzee description convinces me that they must be identical. As my description covers both sexes and the nymphs it seems desirable to include it in full.

Chloretettix viridius Van Duzee.

I took one example of this species at Luquillo, Feb. 11 and Wolcott lists it "at light at Pt. Cangrejos". This would indicate that it is quite rare, at least for the season of collecting, although in the southern United States, it is a very abundant species.

Chloretettix nigromaculatus DeLong & Wolcott.

No specimens of this species were taken during my stay on the island and as the species was described "From a single female at light at Río Piedras" nothing is known as to its food plant. There are two females from Gualan, Guatemala in the Ohio State University collection which agree with the type specimen from Porto Rico and which indicate a considerable range for the species. It may be expected to show up in Haiti, Cuba and probably other tropical localities.

Chlorotettix minimus Baker.

This species has a wide distribution in the tropical Americas from Brazil to Florida, but was not found in abundance at any point during my stay in Porto Rico. Ordinarily it may have considerable economic importance. Taken at Patillas, Jan. 22, Arecibo, Feb. 13, Espinoza, Feb. 6, Guayama, Jan. 12, Feb. 27, Añasco, Mar. 1, Fortuna, Mar. 15, Río Piedras, Feb. 8, Feb. 14, Aguirre, Jan. 18, Ponce, Jan. 21 and Mar. 15.

Chlorotettix tethys Van Duzee.

Chlorotettix tethys VanDuzee. Bul. Buffalo Soc. Nat. Sci., Vol. V, p. 71, 1907.

Chlorotettix bidentatus DeLong, Jour. Dept. Agr. Porto Rico, Vol. VII, p. 264, 1923.

Light green with no dark markings on head, pronotum or scutellum but with more or less distinct fuscous or blackish spots on the elytra; a faint dash next apex of inner cell of clavus, two distinct roundish spots, one on the base of the outer claval cell and one in base of discal cell and two oval or quadrate fainter blotches beyond the middle with smoky tint in apical areoles. Elytra greenish hyaline with faint iridescence. DeLong says of color "Dull greenish yellow, unmarked" and in his type specimen the dusky spots of elytra are scarcely visible, possibly due in part to fading.

Nymphs taken with adults Jan. 23 '29 at Salinas valley on mountain side, bright green, no marking with short scattered blackish hairs on abdomen.

This was the most common species of the genus during my stay in Porto Rico and taken in a variety of habitats, mainly on grasses. San Juan, Feb. 10, Aguirre, Jan. 18, Patillas, Jan. 22, Ponce, Jan. 20. Wolcott records it under *C. bidentatus* on sugar cane, weeds and sweet potatoes.

VanDuzee's description was based on three females collected in Jamaica in 1906. A careful comparison of my specimens in which there is considerable variation in extent and intensity of the dark dots with Van Duzee's description and the description and type specimens of DeLong's *C. bidentatus* convinces me that they are the same.

Jassus obligatus Uhler.

Recorded as from leaves of *Ficus laevigata* at Quebradillas by Wolcott. It did not appear in my collecting.

Cicadula 6—notata Fall.

Taken from grasses at a number of points. A common species, often destructive to grasses and small grain. Its distribution covers most of Europe, and North America to the Canal Zone.

Cicadula 6—notata var.?

Taken on the Cayey Road at near 2,000 ft. elevation. This is larger than typical 6—notata and the black dots on the vertex are broader more squarish and the elytra are clouded more or less with fuscous, forming a fairly definite yellowish white saddle back of the scutellum.

Cicadula maidis DeLong.

This is a distinctly marked species, nearly pure white with two conspicuous round black spots on the vertex close to the anterior border. Specimens were taken in a garden at Ciales, Feb. 9, where a few hills of corn were growing among beans, but not taken where corn was absent. At Río Piedras several small specimens were taken on a vacant lot with mixed weeds and grass but no corn, and specimens were also taken one evening at light at Dr. Cook's residence.

Also at Arecibo, Feb. 13, Mayagüez, Mar. 2, Guayama, Feb. 27. Corn is no doubt its ordinary host as nymphs occur with adults on this plant. Outside of Porto Rico where it was first discovered it has been taken in Cuba.

Balclutha hyalina Osborn.

This species was described by the author (1926) from specimens collected on a sedge at Jaronú, Cuba, and specimens agreeing with the type material were collected in Porto Rico on Cayey Road near Cayey at about 2,000 ft. elevation.

Eugnathodus virescens Osborn.

Examples of this species originally described from Cuba were taken at Río Piedras, Feb. 14 from grass on Insular Experiment Station grounds.

Eugnathodus pallidus Osborn.

Taken at Río Piedras, Feb. 14. Heretofore known from Cuba only.

Eugnathodus abdominalis Van Duzee.

This very widely distributed species in the United States, Mexico, Central America and West Indies was included in Wolcott's list and taken by the writer at Lares, Feb. 12, Arecibo, Feb. 13, Fortuna, Mar. 15, Mayagüez, Mar. 2, Río Piedras and Cayey Road but in smaller numbers, and evidently scarce during the season.

Eugnathodus minutus n. sp.

Small, slender, head distinctly wider than pronotum, slightly tumid; eyes prominent; vertex a little longer at midle than next the eye; pronotum short, longer than vertex; elytra narrow, costa only slightly curved. Female last ventral segment truncate, one half longer than preceding. Male valve hidden or wanting; plates small, triangular, reaching tip of pygofer.

Color pale ash gray, almost white, face and pronotum faintly tinged with yellow or buff; pectus blacknish, legs white; abdomen tinged with greenish.

Length, female 2.75 male 2.50 mm.

Described from a series of five specimens, female (type) male (allotype) and paratypes collected from matted grass at sea level, salt flat association. Aguirre, Feb. 18 and 23, 1929. This is the smallest species known to me; smaller than pallidus or abdominalis which it resembles in form but there are no traces of the stripes on head and pronotum, usually conspicuous on the latter.

Eugnathodus guajanae DeLong.

The arrow leaf hopper, *Eugnathodus guajanæ,* described as occurring in "arrows" of cane was taken in small numbers from cane "arrows" on the few occasions when I had opportunity to examine them and then only by vigorous beating, never on cane not in bloom. It was taken frequently in sweeping grass even when far distant from cane and it seems evident that it is a general grass feeder and occurs on cane only when it is in bloom. As its presence in the arrows can have very little economic importance unless it is shown to be a carrier of some plant disease its relation to cane may be considered negligible. On grass it may be of some consequence although in collections that I made it has never appeared in great abundance but most commonly on native grass which has possible forage value on the hillsides.

Like many other species its importance depends on abundance on a crop of agricultural value and it may have been much less abundant the past winter on account of storm.

Eugnathodus bisinuatus DeLong.

Recorded by Wolcott for several localities and described as from seed heads of malojillo grass, *Panicum barbinode.* Also mentioned as occurring on sugar cane, sweet potato, carrots, sedge and bermuda grass. I collected it at Vega Alta Feb. 6 and Río Piedras Feb. 8, etc.

Eugnathodus rosaceus n. sp.

Head slightly wider than pronotum; vertex short, rounded anteriorly, faintly angulate, two thirds as long as the pronotum; female last ventral segment as long as preceding and broadly rounded on posterior border. It is quite distinctly polished as are other segments of the abdomen in most specimens.

The color is a bright pink or reddish rose color, specimens varying from bright pink to reddish or rose red, the whole body above and beneath as well as elytra being suffused with the color in varying intensity.

Length 3.5 mm.

Described from a series of twenty females collected from seed heads of a sedge *Fimbristylis spadicea* at Aguirre Feb. 18 and 23.

Protalebra cordiae n. sp.

Head scarcely as wide as base of pronotum; vertex subangular, rounded to front; elytral appendix narrow. Female last ventral segment elongate, twice as long as preceding segment and narrowed, produced on hind border with a median black tip. Pygofer with pale bristles; ovipositor yellowish. Male plates narrow, elongate, tapering to acute tips extended to tip of pygofer. Under and seen through the subhyaline plates near the base two points are visible, probably tips of male claspers.

Color white, the head with disk of vertex, a band between eyes and lower part of face yellow; propleura and base of elytra orange, tip of scutellum black. Elytra tinged with greenish, crossed by an oblique black line at middle of clavus, bordered behind with white; four black longitudinal lines or dashes, one, short, on clavus, two sinuate or arcuate on disk of corium and one strongly arcuate near costa reaching to cross veins where they merge with a black line before the crossveins; cross veins white, bordered behind with black which extends along costa to apical cell; the membrane clouded with smoky on the disk; tibial spines and tarsal claws black.

Length 2.5 to 3 mm.

Taken in numbers from *Cordia* sp. at Aguirre, males, females and nymphs occurring on the under side of leaves Jan. 17 and Feb. 18. Also at Coamo, Jan. 13, 1929.

The nymphs associated with the adults and quite certainly of this species, though not bred, are white, faintly tinged with yellow and in fresh specimens the eyes are greenish white as in the adults. The head, thorax, wing pads and abdomen are set with scattered, stiff, black hairs.

The species is somewhat similar to *P. curvilinea* but the picture is different. It has been taken only on the *Cordia* which may be considered a normal if not an exclusive host.

Protalebra lenticula n. sp.

Head as wide as pronotum, vertex produced, subangulate, rounded at tip, as long as pronotum; pronotum narrowed anteriorly, strongly curved, hind border scarcely concave; scutellum small, tip acute; elytra with costa distinctly convex, appendix narrow. Female last ventral segment elongate, angular; male, valve minute or hidden, plates elongate triangular, with acute tip, borders with white cilia.

Ivory or milky white, the anterior part of pronotum banded or suffused with pale orange, scutellum with black dots in the angles, the apical one larger; elytra milky hyaline, a distinct curved narrow blackish band just back of the scutellum, preceded by an orange brownish area, central part forming a broad white saddle or band with two faint longitudinal golden yellow stripes reaching to a broad blackish band with angular anterior projections on cross nerveures, and faint smoky patches on the membrane.

Length 2.5 mm.

Described from a series of fifteen specimens, ten females, five males, female (type) and male (allotype) and thirteen paratypes in authors collection collected at Coamo, P. R., Jan. 13, 1929.

Protalebra similis Baker.

A specimen collected at Espinoza in low ground mixture of weeds adjacent to tomatoes. A previous record by the writer in Annals Carnegie Museum (1928 p. 264) is based on a specimen from Vega Baja which is, rather curiously, not distant from the point where I took the specimen here recorded. I have also a specimen from Mayagüez collected by Mr. W. V. Tower.

Protalebra ziczac n. sp.

Head produced, vertex angular, as long as pronotum, a trifle longer than width between the eyes; elytra long, appendix narrow at base, widening to apex. Female last ventral segment long, twice as long as preceding, hind border nearly truncate.

Pale yellow, vertex and pronotum tinged with orange, base of vertex and three diffuse spots on disk, base of pronotum except for a narrow black line, inner border of clavus and zigzag lines on the elytra whitish, borded with black; base and apex of clavus and discal area on corium greenish orange; cross veins in part yellow; apical veins white bordered with blackish; beneath pale yellow or whitish, base of apical tarsal joint dusky.

Length 2.75 mm.

Described from one female (type) swept from mixed grass and weeds near Mayagüez in the Añasco valley Mar. 1, 1929.

This has the general appearance of *similis* but the white markings on the elytra have a distinctly different angular picture.

Protalebra tabebuiae Dozier.

Protalebra tabebuiae Dozier. Jour. Dept. Agr. Porto Rico, Vol. X, p. 260. 1927 (Sept.).

Protalebra bicincta Osborn. Annals Carnegie Museum, Vol. XVIII, p. 259. 1928 (May).

I took this species in considerable numbers from "robles" on the Station grounds at Río Piedras. One small tree was so much infested as to have the leaves whitened. Apparently restricted to this tree as a host plant as no other occurrences have been noted. I described the species from specimens sent me by Dr. Dozier but publication was delayed and his description, appearing a few months before mine was printed had failed to come to my notice. In my note with the description the word "robles" has been translated for me as "oaks" but the name roble is applied in Porto Rico to trees of the general *Tabebuiæ* and *Bourreira* according to Cook and Gleason.

Protalebra bifasciata Gillete.

Dozier (4) records a specimen taken by beating a thorny leguminous bush at Juana Díaz Feb. 11, 1925.

Protalebra aureovittata DeLong.

> ***Alebra aureovittata*** **DeLong.** Jour. Dep. Agric. Porto Rico, Vol. VII, p. 267. 1923.
>
> *Protalebra pallida* Osborn. Annals Carnegie Museum, Vol. XVIII, p. 260. 1928.

Specimens were taken at Yabucoa Jan. 19 and on the Cayey Road near Cayey at about 2,000 ft. elevation on Jan. 28.

The specimens I described as *pallida* from San Sebastián have the yellowish stripes very faint but I believe they should be placed with the other under one specific name, though additional material may warrant a varietal name.

Empoasca sex-maculata DeLong.

Described from specimens taken from "emajagua" *Partium tiliaceum* at Pt. Cangrejos. No specimens were encountered in my collecting.

Empoasca fabae Harr. (*E. mali.* auct.)

Abundant and destructive throughout Tropical America and in United States north to Canada. Affects beans, potatoes, etc.

Taken at many points. On morning glory, beans etc.

Empoasca flavescens Fabricius.

This is entered in Wolcott's list on authority of Dr. DeLong and it is difficult to separate records which may refer to this species from those referring to *E. fabæ.* The two species have been confused in literature and until more definitely separated it will be difficult to place the various records.

Empoasca minuenda Ball.

This was described as occurring on avocado leaves in Florida and Dozier records it from the same host in Porto Rico.

Joruma pisca McAtee.

Recorded by Dr. Dozier as collected at Aguirre.

Joruma brevidens DeLong.

A specimen referred to this species was taken near Loíza (old) sweeping a rank weed at margin of river, close to wild cane.

Described as *Empoasca brevidens* but DeLong (3) remarks that the venation differs from that of typical *Empoasca*—and it evidently belongs to the group later characterized as *Joruma* by McAtee (5).

Dikraneura marginella Baker.

In mixed grasses at Experiment Station. One specimen. This species was not recorded by Wolcott but is common to West Indies and Central America to the Canal Zone.

Dikraneura (Hyloidea) **depressa** McAtee.

McAtee described this species from specimens taken by G. N. Wolcott at Vega Alta and Dozier (4) repeats his description and adds other records. It did not appear in any of my collections and may be rare.

Typhlocybella minima Baker.

Common to sub-tropics or neotropic America. Occurs probably on a variety of grasses of which Guinea grass is definitely one. Taken in Porto Rico at Yabucoa Jan. 29, Río Piedras, Feb. 8, Arecibo, Feb. 13 on grasses, at Aguirre on Guinea grass, Feb. 20 & 29. The species may have economic importance as it occurs quite commonly on pasture grasses.

FULGORIDÆ

Bothriocera venosa Fowler.

Taken at a great many localities and in a variety of habitats from Mangrove association in salt flats to mountain roadsides.

Oliarus franciscanus Stal. (=*Oliarus cinereus* Wolcott)

One of the most generally distributed species of Fulgorid and occurring in great variety of habitats. Adults occur on a great variety of hosts and Mr. Seín * has found that the nymphs occur on the roots of sugar cane and malojillo which has a very interesting possibility in the transmission of mosaic or other diseases.

The species is known throughout the tropics and over a large part of the United States and has received several latin-names due to this wide distribution.

Cubana tortriciformis Muir.

Described by Dr. Muir from one female from Mameyes 3,000 ft. elevation. I have not recognized it in any of my collections.

Cedusa inflata Ball ?

Specimens collected at Añasco March 1st are referred with some doubt to Dr. Ball's species described from Haiti.

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* Annual Report, Insular Experiment Station of Porto Rico for 1927–28 (1929) p. 90.

Cedusa edentula Van Duzee.

A number of specimens collected at Añasco March 1st agree very well with specimens in my collection. The species has been known heretofore from New Jersey to North Carolina and if our identification is correct it means a much wider distribution for the species.

Cedusa wolcotti Muir.

Dr. Muir described this species from material collected at Yauco, August 24, 1923 and said to be feeding on Palm. In my own experience I found the palms very free from any of these insects, but they may have a seasonal occurrence. None of my specimens seem to agree with the description of this species.

Dysimia maculata Muir.

Reported in the description as feeding on two species of *Inga*, *I. vera* and *I. laurina* in August.

Parahydriena hyalina Muir.

Dr. Muir in his description states that the specimen of female from which his description was drawn was from Lares June 14, 1921.

Tangia angustata Uhler.

Recorded by Wolcott from several food plants. Not recognized in my collections unless specimens from *Guilandina crista*, near San Juan, may possibly be referred here.

Neurotmeta sponsa Guerin.

One specimen which seems to agree well with the descriptions of various authors for *sponsa* was collected from a small tree on the Cayey Road near Cayey at an elevation of about 2,000 ft. It is pale yellowish green, the elytra hyaline tinged with yellowish.

Monopsis viridis Walker.

Specimens, agreeing with Walkers description, were collected from Mangrove, *Conocarpus erecta* at Aguirre. Feb. 18 and from various woody plants at Salinas, Mar. 12. I do not find later records for this species and it may have been referred to some earlier described from but the description as given by Walker (1851) fits my specimens very exactly.

Catonia intricata Uhler.

Uhler's description was from one specimen from St. Vincent and while apparently a little larger I think the characters given warrant placing the Porto Rican specimens here, at least tentatively. One specimen from Yabucoa Jan. 29 and one from Lares Feb. 12.

Pintala (Cotyleceps) **decorata** Uhler.

A single specimen referred to this species was taken at Lares Feb. 12. Uhler's specimen was from St. Vincent and he established the genus *Cotyleceps* to include it but Muir places the genus as a synonym of *Pintala* Stal.

Thionea sp.

Wolcott includes a record under this heading as "det Muir" but I did not secure any specimens of the genus.

Colpoptera brunneus Muir.

Dr. Muir lists Utuado, Toa Alta, "Cicales" (sic) Ciales (?) as localities from which type material was used. This is probably one of the forms included under *Cyarda* in Wolcotts "Insectae" as he mentions "Ciales" as one of the localities under that name.

Colpoptera maculifrons Muir.

Muir's description is based on one male collected at Río Piedras by R. T. Cotton, Jan. 10, 1917.

Specimens referred to this species were taken at many points but occurred in large numbers, both as adult and probably nymphs, on "fiddle wood" (*Pedula*)? at Salinas, March 1. It was taken on sea grape as adult at Cataño and Salinas and in sweeping from *Lantana* at Yauco, and on *Barita* at Tallaboa, March 11. What appear to be nymphs were swept from shrubs and bunches of grass at Salinas in Feb.

Acanalonia brevifrons Muir.

The description by Dr. Muir is from one male from Pt. Cangrejos collected by Wolcott June 24, 1920. I have seen the type in the U. S. National Museum and it does not agree at all with specimens I collected at various points and described below.

"**Acanalonia sp.**"

Wolcott lists an "Acanalonia sp. nov." "det Muir" near *depressa Melichar*" as "on shrub in woods at Seboruco, Laguna de San José" which would seem to be different from the one above; possibly the same as I describe below.

Acanalonia coniceps n sp.

Head narrower than pronotum, acutely conic; vertex flattened margins converging to acute tip; front as wide as long, somewhat tumid, widening below, margins elevated; elytra broad, costa strongly convex; neuration conspicuous, reticulate, concolorous except costa and mid-vein which are narrowly pale yellow. Color bright green; a pale green or yellowish green median stripe from vertex to scutellum. Face and below paler, tibia pale brown.

Length to tip of elytra 9 mm.

Described from a series of six specimens collected at Salinas, Jan. 21 and March 12 on bushes and rank grass.

Ormenis infuscata Stal.

Recorded by Wolcott as occurring on sugar cane, grape fruit and coffee, but I did not find it in any numbers.

Ormenis marginata Brunnich.

Taken in large numbers on a variety of plants, especially on *Lantana* and *Cordia* at Yauco and Ensenada, Aguirre and other points throughout the island.

Ormenis pygmaea Fabricius.

Very abundant on a variety of plants and taken in nearly every locality where collections were made, so that it must be considered a very general feeder. Wolcott's extended list of host plants is representative of its very general food habits.

Ormenis quadripunctata Fabricius.

This is another very common and abundant species occurring on many different plants and in Wolcott's report credited with occurring in all stages on sugar cane as well as *Cordia*, *Lantana* and other host plants. I found it particularly abundant on "fiddle wood" (*Pedula?*) trees near Salinas.

Ormenis pseudomarginata Muir.

This species was described by Muir (1924) from one male from Porto Rico (R. T. Cotton, January, 1917) and one male from Lares, Porto Rico (J. More, Dec. 1920). I have not seen specimens that could be placed here and no indication is given as to habitat.

Flatoides sp. s.

Wolcott records two species in this genus without specific name and Muir describes *F. brunneus* from Santo Domingo. I took large numbers at Salinas on Fiddlewood and other tree trunks and no sea grape but they do not agree with Muir's description or other species I have been able to compare them with. Several species which might include my specimens have been described and I believe it best not to give a new description here.

Copicerus irroratus. Schwartz.

This is a very widely distributed species in subtropical America occurring in the other West Indian islands and in Mexico and Central America, south to Guatemala, Nicaragua and Panama; but only one specimen was taken in Porto Rico, at Añasco, March 1, so I conclude it must have been exceedingly rare in the localities in which I collected. No previous records for the island appear to have been made.

Stobaera tricarinata Say.

A specimen agreeing very well with representative specimens from the States was taken at Aguirre, Feb. 18. Not recorded by Wolcott.

Megamelanus elongatus Ball.

Specimens taken on beach grass near San Juan Feb. 10th are slightly smaller than specimens I have from New Orleans, La., but agree so closely in other respects that I believe them to be one species. They are evidently confined to beach grass as food plant.

Pissonotus albovenosa Dozier.

Taken at Río Piedras in the Experiment Station garden Feb. 14. This is a strikingly marked little species hitherto known from Mississippi.

Saccharosydne saccharivora Westwood.

This common and widely distributed species is well known as occurring on sugar cane and is at times quite injurious. It was taken at a number of localities but at no time during my stay was it found in great numbers on cane. It was taken at different times on grasses, sometimes at points quite distant from cane fields.

Peregrinus maidis Ashmead.

Taken on corn at Ensenada, Tallaboa and Ciales and doubtless occurs generally where corn is grown. The species is known for many different countries including Cuba, Southern United States, Hawaii, Ceylon and South Africa. It is of special interest in connection with possible transmission of mosaic disease, but it does not appear to breed on sugar cane. Occurrence of adults on this plant might, however, serve as a means of transmission for plant diseases ocurring on grasses or corn.

Neomalaxa flava Muir.

Recorded by Wolcott as occurring on cohitre grass *Commelina elegans* at different points.

Nilaparvata wolcotti Muir.

Wolcott records this as occurring on malojillo grass at Pt. Cangrejos.

Sogota cubanus Crawford.

This species is reported by Wolcott as occurring on rice, carrots and sugar cane. I took it at Río Piedras Feb. 14, Cayey Rd. Jan. 28.

Sogata approximata Crawford.

Reported as occurring on malojillo grass at Pt. Cangrejos and on grasses in cane fields by Wolcott.

Delphacodes havanensis Crawford.

Reported by Wolcott as occurring on malojillo grass at Pt. Cangrejos.

Delphacodes humilis Van Duzee.

This abundant species on grasses was recorded for malojillo grass at Pt. Cangrejos and on Guinea grass by Wolcott. Specimens referred here were collected at numerous points.

Delphacodes propinqua Fieber.

Another common species for the West Indies and adjacent mainland. Recorded for malojillo grass by Wolcott. Our records are for Río Piedras, Aguirre, Mayagüez, and Fortuna.

Delphacodes teapae Fowler.

This is one of the most abundant species of Delphacid on the island and was taken at practically every locality where I collected. Wolcott says "at light, on sugar cane, on malojillo and carpet grass, carrots" etc. I took it most abundantly on grasses and frequently adjacent to sugar-cane fields.

Delphacodes albolineosa Fowler.

Specimens referred here were taken at Río Piedras, Feb. 14.

Delphacodes andromeda Van Duzee.

Taken at Patillas Jan. 22 and Lares Feb. 12th.

Delphacodes erectus (var. **nigripennis**) Crawford.

Salinas March 12 and Cayey Road at about 2,000 ft. elevation March 16.

Delphacodes puella Van Duzee.

Taken only rarely and in small numbers. Aguirre Jan. 18, Añasco March 1.

Delphacodes lutulenta Van Duzee.

Specimens agreeing closely with specimen taken in the States were taken at Río Piedras, Mayagüez, Cayey road and Aguirre.

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THE MIDDLE AMERICAN SPECIES OF THE GENUS INGA

By

HENRY PITTIER

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By HENRY PITTIER.

INTRODUCTION

In 1916, the writer published a "Preliminary Revision of the genus Inga[1], based mainly on the American collections at Harvard, New York, Chicago and the Donnell Smith Herbarium at Baltimore. In that paper, about forty new species or aberrant forms were described, bringing the number of known types up to 212. Since then, a relatively large number of new species have been described, so that the total may now reach about 250. This is not the place to discuss the recent creations, which, like several of my own, may prove later to lack a good foundation. This may happen especially when they belong to that wonderfully polymorphic group of the *Euingæ-Sulcatæ*, which are evidently still in full evolution and show the most unexpected variations in their characters. With regard to the Central-American new species, I will add that I have accepted them indiscriminately all but one, which was rejected for reasons which will appear at the corresponding place.

With reference to the nomenclature, it should be explained that, for brevity's sake, I have given only the name with priority's rights and made away altogether with the often cumbrous synonymy, which can easily be found elsewhere when really needed.

During the last three or four decades, a large number of Inga species have gradually acquired great importance as shade trees in coffee culture. In Costa Rica in particular, and in Central America generally, greater attention has been paid to the important question of sheltering the plantations against intense insolation as well as against the violence of the wind. A first, the natural shade of the forest was considered as the ideal condition, until its many disadvantages became evident. Then shade was provided for by planting any kind of trees at the time when the coffee seedlings were put into the ground. At this stage of experimentation, it was noticed that the coffee shrub would not thrive in the close proximity of certain trees, either because of the shade not being adequate or on account of other contrary influences, while on the other hand, it assumed a prosperous aspect under the protection of other trees, these all belonging to the order *Leguminosæ*. The excellence of the shade alone could not, however, explain completely this favorable action, part of which was with reason attributed to the fact that the rootlets of most, if not all, Leguminous trees, are loaded with colonies of the famous bacterias discovered by Hellriegel and Willfarth, and act consequently as true nitrogen reserves, that element being further used for the continuous restoration of the soil. This property of the leguminous plants had long been known, though but as a part of the hereditary routine, to the farmers and even to the primitive Indians. Without knowing the reason why, the peasants of Central America had been aware for many generations, that any weed of the above-named family did benefit the soil, and among the primitive tribes acquainted with cacao, the custom was to have either some species of *Inga* or a tree of madre-de-cacao (*Gliricidia*) planted near every one of the cacao-trees scattered in the forest and under semi-cultivation.

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[1] Contr. U. S. Nat. Herb. 18: 167–224. 1916.

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In coffee and cacao culture, the first leguminous trees to enjoy the preference of the planters seem to have been species of *Erythrina*, some of which are still used to a large extent, outside of Central America especially. Their disadvantages, however, have little by little become evident: being almost always of very large dimensions, they are apt to exhaust the soil at the expense of the coffee shrub; their branches are too high to permit the regulation of the shade; many of them bear spines which are dangerous to the feet of the laborers; being deciduous they are entirely despoiled of their foliage, just at the time when the plantation is most in need of shade, and finally, as they grow old, they become more breakable and the fall of entire limbs brings havoc upon the coffee-trees. For all these and other reasons, the consensus of opinion among thinking planters has grown more and more adverse to the use of Erythrinas as shade trees, and their substitution by species of *Inga* has become more general. The trees of this genus are scattered all over Tropical America, but as it is in Central America and Mexico where the question of shade in coffee-culture has received the greater attention, the selection of the better-adapted species is also more advanced there, and the study of the species growing in that area of more importance. The object of this paper is mainly to give every coffee or cacao planter a good descriptive knowledge of these useful trees, and in another contribution which is now in preparation, the whole question of the shade and of the use of windbreakers will be discussed and the adaptability and convenience of each one and all the acceptable shade trees according to local conditions presented in the light of our present knowledge of the matter.

DEFINITION OF THE GENUS

INGA. Scop., Introd. 289. 1777.

Flowers pentamerous, calyx tubulous or campanulate, toothed, or short laciniate. Corolla tubulous or funnel-shaped, the petals adnate from the base to more than half their length (i. e. corolla gamopetalous). Stamens numerous, exserted, adnate on part of their length in a stamen tube. Ovary sessile or stipitate, with several or many ovules. Legume sessile or short-stipitate, straight or curved, flat, tetragonous or almost terete, usually with thickened sutures, indehiscent or hardly dehiscent, the seeds almost invariably surrounded with a white, sweet pulp. Trees or shrubs with pinnate leaves, the rachis of these oftentimes winged between and below the leaflets, sometimes wingless, and provided at the insertion of the leaflets with sessile or stipitate glands. Inflorescences umbellate, capitulate or spicate, single or clustered in the axils of the leaves or subpaniculate at the end of the branchlets. About 250 Neotropical species, of which 58 are spread over Middle-America.

SECTIONS AND SERIES OF INGA IN MIDDLE-AMERICA

Every section and series of Inga, as revised in the paper cited above, is represented in Middle-America, with the exception of series *Glabriflores* and *Lepanthæ* of section *Pseudinga*. These subdivisions may be distinguished by means of the following key:

KEY TO THE MIDDLE-AMERICAN SECTIONS OF GENUS INGA

Legume flat, the margins rounded, more or less thick, the sides mostly broad
  Flowers distinctly and often long pedicellate, inserted on a very short receptacle and forming an umbellate inflorescence. Sect. 1. LEPTINGA.
  Flowers sessile or very short-pedicellate
    Calyx and corolla glabrous, the former often diminute
      Inflorescence capitate, the receptacle globose or clavate Sect. 2. DIADEMA.
      Inflorescence racemose or shortly spicate; calyx very short Sect. 3. BOURGONIA.
    Calyx well developed, rarely glabrous; corolla very rarely glabrous, usually silky pubescent or villous Sect. 4. PSEUDINGA.

Flowers short and slender, the corolla not over 2.5 cm. long (*Tenuiflorae*), Fl. pubescent or villous.

Rachis of the leaves wingless or almost so, or marginate below the upper pair of leaflets only; glands sessile or rarely obsolete Ser. (*a*) *Gymnopodae*

Rachis of the leaves winged, but the wings rather narrow and sometimes obsolete Ser. (*b*) *Pilosiusculae*

Flowers long and slender, the corolla not less than 2.5 cm. long, or shorter, but then very broad or the leaves villous-hairy (*Grandiflorae*)

Bractlets persistent; calyx glabrous, puberulous or rarely pilose; flowers 2.5 cm. long or over Ser. (*c*) *Calocephalae*

Bractlets caducous

Glands long stipitate; leaves and branchlets coarsely hairy or setose; corolla 2.5 cm. long or over Ser. (*d*) *Vulpinae*

Glands sessile or short stipitate; leaves pubescent, villous or hispid

Corolla 2.5 to 5 cm. long, slender Ser. (*e*) *Longiflorae*

Corolla 2.5 cm. long or less., thick Ser. (*f*) *Dysanthae*

Legume tetragonous or cylindrical, the margins broad or many-sulcate Sect. 5. EUINGA

Legume tetragonous; leaves generally large and rufescent Ser. (*a*) *Tetragonae*

Legume cylindrical, many-sulcate; leaves smaller or the leaflets narrower. Ser. (*b*) *Sulcatae*

DESCRIPTION OF SPECIES

Section 1. LEPTINGA

Flowers glabrous or tomentellous, distinctly pedicellate on a short receptacle and forming an umbel-like head. Rachis of the leaves wingless or more or less winged; glands substipitate or long-stipitate.

Flowers nearly glabrous; rachis of the leaves more or less winged; leaflets 2–jugate
Calyx about 25 mm. long, the pedicels about four times shorter; rachis winged from the base 1. *I. portobellensis*
Calyx 3 mm. long, the pedicels about 3 times longer; rachis winged towards the apex only 2. *I. gracilipes*
Flowers tomentellous, the pedicels as long as or longer than the calyx; rachis of the leaves terete
Branchlets, leaves and pods villous; leaflets 4 or 5–jugate. Glands long-stipitate 3. *I. saffordiana*
Branchlets and leaves not villous; leaflets 3 or 4–jugate
Leaflets elliptic, 1 to 2.5 cm. broad; flowers about 9 mm. long from base of pedicels to tips of corolla lobes 4. *I. Williamsii*
Leaflets ovate or obovate, 1.5 to 8.5 cm. broad; flowers 14 to 18 mm. long from base of pedicel to tips of corolla lobes 5. *I. roussoviana*

1. **Inga portobellensis** Beurling. Svensk. Kongl. Vetensk. Akad. Handl. 1854: 122.

A tree, completely glabrous: branchlets terete, with grayish bark. Rachis of the leaves winged from the base, 8 to 10 cm. long, the petiolar part 2 to 3.5 cm., the wings between the leaflets accrescent from the base, with a rounded apex, 1.5 to 2 cm. broad; leaflets 2-jugate, coriaceous, sessile, the basal pair subdeciduous; glands large, subsessile, concave; blades obovate-oblong, rounded and subemarginate at the base, abruptly acuminate at the apex, dark green above with the costa and nerves impressed, beneath paler or brownish with prominent nervation, those of the basal pair 10 to 14 cm. long, about 10 cm. broad. Inflorescences axillary or terminal, single; peduncles about 4 cm. long; bractlets lanceolate or ovate, calyx tubular, finely striate, about 25 mm. long; 6 to 8 mm. long, caducous; pedicels thick, 5 to 6 mm. long; corolla tubular, broadened at the apex, 35 to 38 mm. long, the teeth short, acute, cano-pubescent; stamen tube exserted; style capitellate. Legume flattened, thick, straight, with a very thick margin; seeds 16 to 20.

Type collected at Porto Bello, Panamá, by Billberg. Specimens examined:

COSTA RICA: Around Santo Domingo de Osa, flowers March, 1896, Tonduz (Ins. Fis. Geogr. Costa Rica, No. 9879).

2. **Inga gracilipes** Standley, Journ. Wash. Acad. **15**: 101. 1925.

A tree about 6 m. high, the young branchlets sparsely puberulent at first, almost glabrous later. Rachis of the leaves narrowly winged between the two pairs of leaflets only, 3 to 5 cm. long, the petiolar part 1.5 to 3 cm., the wings attenuated towards the base; leaflets 2-jugate, coriaceous, sessile, elliptic-oblong, abruptly and shortly obtuse-acuminate, glabrous and lustrous above with prominent venation, 6–11 cm. long, 2.5–4.5 cm. broad; glands sessile, cupshaped. Inflorescences axillary or terminal, the umbels paniculate; peduncles very slender, 2.5–4.5 cm. long, solitary or fasciculate; pedicels filiform, 8–10 mm. long; calyx tubular, 3 mm. long, minutely puberulent; corolla narrow-funnelform, 8 to 9 mm. long, glabrous; stamen tube short-exserted. Young legume flattened, oblong, the margins hardly thickened.

Type from a brushy slope between France Field, CANAL ZONE, and El Catival, province of Colón, PANAMÁ, near sea level, January 9, 1924 (P. C. Standley No. 30353, in U. S. Nat. Herb.)

3. **Inga saffordiana** Pittier, Contr. U. S. Nat. Herb. **18**: 176. 1916.

A small, slender tree, the young branchlets densely set with long, brown hairs. Rachis of the leaves terete, villous, 5 to 12 cm. long; stipules subulate, villous, 5 to 12 mm. long; leaflets 4 to 5-jugate, leathery; glands very small and long stipitate; petiolules villous, 2 to 3 mm. long; blades more or less oblique, ovate to lanceolate, acuminate, glabrous on the faces except on the costa and veins, sparsely long ciliate on the margin, 3.5 to 14 cm. long, 2 to 4 cm. broad, the terminal pair largest. Inflorescences axillary or issuing from the trunk, single, the peduncles villous, 4 to 13 cm. long; pedicels 1.5 to 2 cm., villous as are the subulate, 5 to 10 mm. long, persistent bractlets; calyx, corolla, etc., not known. Legume 15 to 32 cm. long, 2.5 to 3 cm. broad, densely brown-villous, cuneate at the base, rounded emarginate and mucronate; seeds up to 17 to each pod.

PANAMÁ: Forests of Cerro de Garagará, in the Sambú Valley, southern Darién, at an altitude of about 500 meters, young pods, February 8, 1912, *Pittier* 5676; type.

4. **Inga Williamsii** Pittier, Contr. U. S. Nat. Herb. **18**: 176. 1916.

A small tree. Rachis of the leaves grayish or brownish tomentose, 5 to 7.5 cm. long; leaflets 3 to 4-jugate, the petiolules pubescent, 2 to 3 mm. long, the blades elliptic, 2 to 8.5 cm. long, 1 to 2.5 cm. broad, with the costa and veins prominent beneath and pubescent on both sides. Umbels single or geminate in the upper axils; peduncles ferruginous-tomentose, 1 to 1.5 cm. long; pedicels densely pubescent, 3.5 to 4 mm. long; calyx villous-pubescent, 3.5 to 4.2 mm. long; corolla densely villous, 5.2 to 5.9 mm. long; staminal tube hardly exserted. Legume not known.

PANAMÁ: Bismarck, above Penonomé, province of Coclé, flowers, March 5, 1908, *Williams* 285; type.

5. **Inga roussoviana** Pittier, Contr. U. S. Nat. Herb. **18**: 32, pl. 82. 1916.

A small tree. Rachis of the leaves ferruginous-pubescent or glabrous, 12 to 15 cm. long; leaflets 3 to 4-jugate, glabrous or pubescent, the petiolules about 4 mm. long, the blades ovate or obovate, 4.5 to 18 cm. long, 2.5 to 8.5 cm. broad, the terminal pair largest. Umbels forming panicles on short axillary or terminal shoots, and single or 2 to 4-fasciculate on the defoliated nodes; peduncles grayish or brownish tomentose, 1 to 1.5 cm. long; pedicels pubescent, 4 to 7 mm. long; calyx pubescent, 5 mm. long; corolla long funnel-shaped, 9 to 11 mm. long, densely villous; stamen tube inclosed or slightly exserted. Legume pedunculate, ferruginous-pubescent, rounded at the base, apiculate, 11 to 17 cm. long, the sides 2 to 2.3 cm. broad, the margin prominent.

PANAMÁ: around San Félix, eastern Chiriquí, in woods, flowers, December 23, 1911, *Pittier* 5270; type.
COSTA RICA: Vicinity of Santo Domingo de Osa, in forest, fruits March 1896, *Tonduz* (Inst. Fís. Geogr. 10032).
BRITISH HONDURAS: Punta Sierra, on the banks of a highland creek, flowers January 16, 1903, Percy *Wilson* 41.

Section 2. DIADEMA

Flowers glabrous or pubescent, often small, capitate at the end of a clavate peduncle, sessile or short pedicellate, in the latter case the stipules large and persistent and the pedicels not longer than the calyx. Rachis of the leaves wingless, terete or narrowly canaliculate. Glands small or obsolete. Peduncles long, axillary.

- Stipules small, caducous; flowers sessile. Leaves and flowers glabrous or almost so
  - Leaflets very short-petiolulate, or subsessile, membranous 6. *I. membranacea*
  - Leaflets distinctly petiolulate, coriaceous
    - Floral peduncles very short; receptacle ovoid; stamen tube exserted 7. *I. Peckii*
    - Floral peduncles rather long (3 to 8 cm.); receptacle globose; stamen tube included 8. *I. Jinicuil*
- Stipules large, persistent; flowers pedicellate
  - Leaflets 4 or 5-jugate; glands sessile; corolla 3.5 to 7.5 mm. long; legume fewseeded, stipitate 9. *I. paterno*
  - Leaflets 3 or 4-jugate; glands at least substipitate; corolla 8 to 8.5 mm. long; legume many seeded, rounded at base 10. *I. radians*

6. **Inga membranacea** Benth. Trans. Linn. Soc. London, **30**: 606.

Plants subglabrous. Leaflets 2 or 3-jugate, very short petiolulate, ovate-elliptic, obtuse-acuminate, 5 to 8 cm. long, membranous, nitidulous, venulous. Peduncles slender. Flowers sessile, glabrous. Calyx 3.2 mm. long; corolla 6.3 mm. long. Legume not known.

Type collected in Veragua, Panamá, by Seemann.

This species I have not seen.

7. **Inga Peckii** Robinson, Proc. Amer. Acad. **49**: 502. 1913.

Branchlets terete, more or less geniculate, the grayish bark covered with numerous lenticels. Rachis of the leaves wingless, angular, striate, about 15 cm. long; leaflets 2 or 3 jugate, petiolulate, subcoriaceous; petiolules 4 to 6 mm. long; leaflet blades -oblong acuminate at the base and apex, almost lustrous above, opaque or subglabrescent beneath, 9 to 17 cm. long, 3.5 to 7.5 cm. broad. Inflorescences many-clustered in the axils of the leaves; peduncles short and slender, pubescent (?); receptacle ovoid; flower head ovoid, often 18 to 20-flowered, sessile; calyx about 2 mm. long, subcylindraceous, short toothed, the teeth obsculery ciliate-hispidulous; corolla glabrous, tubular, slender and slightly broadening toward the apex, the lobes very short and deltoid; stamen tube exserted. Legume glabrous, falcate-oblong, about 13 cm. long, 2.2 broad, 11-seeded.

Type (in Gray Herbarium) collected in BRITISH HONDURAS, by Morton Peck No. 673.

This species, which I have not seen, is said to be nearly related to *I. Jinicuil* Schlecht. It differs in its much shorter peduncles, thicker, duller, and less reticulate leaflets, shorter corolla teeth and exserted stamen tube.

8. **Inga Jinicuil** Schlecht. Linnaea **12**: 559. 1838.

A medium-sized tree. Branchlets slender, flexuous, glabrous, the grayish bark densely covered with white prominent lenticels. Leaves entirely glabrous; rachis subterete, slightly thickened at the insertion of the leaflets, 6 to 10 cm. long; stipules caducous, oblong, obtuse, 5 to 7 mm. long; leaflets 3-jugate, coriaceous, long-petiolulate; glands (when present) more or less prominent and flat at the apex, but mostly obsolete; petiolules about 5 mm. long, thickened; leaflet blades ovate to elliptic, cuneate at the base, acute or acute-acuminate at the apex, lustrous, dark green above, with the costa impressed and the veins slightly elevated, beneath paler and delicately prominent-reticulate, the blades of the basal pair 4 to 8 cm. long, 1.5 to 3 cm. broad, those of the terminal pair 8 to 12 cm. long, 3.5 to 5 cm. broad. Flower heads 1 to 6 in the axils of the leaves or on the nodes of defoliate branchlets; peduncles glabrous or minutely pubescent, 3 to 8 cm. long; receptacle globose, 3 or 4 mm. in diameter; flowers sessile; calyx tubular, often stipitate, strigose-pubescent, 2.3 to 3 mm. long, the teeth small, obtuse, incurved; corolla broadly tubular-infundibuliform, 6.5 to 7.1 mm. long, the lobes narrow, acute, about 2 mm. long, minutely glandular-pubescent at the tip; stamen tube inclosed; pistil about 8 mm. long; ovary glabrous, substipitate, 2 mm. long; style truncate. Legume (according to Bentham and Schlechtendal) glabrous, the seeds 6 to 10, immersed in a white pulp. Specimens examined:

MEXICO: Jalapa, Veracruz, alt. 1400 meters. *Schiede*, type collection, represented by 3 sheets in the Gray Herbarium. Córdoba Valley, Veracruz, flowers April 27, 1866, *Bourgeau* 2043 bis; Jalapa, Veracruz, alt. 1300 meters, flowers April 13, 1899, *Pringle* 3134, Teocelo, near Jalapa, Veracruz, in coffee plantations, alt. 1218 m. flowers May 8, 1901, *Goldman* 690; Orizaba, alt. 1264 meters, flowers March 27, 1867, *Bilimek* 135.

9. Inga paterno Harms, Repert. Spec. nov. **13**: 419. 1914 (Pls. XIII, XIV.)

A medium sized tree; branchlets glabrous, lenticellose. Leaves glabrous or glabrescent; rachis more or less marginate between the

leaflets, 8.5 to 15 cm. long; stipules obovate to oblong, 1.5 to 2 cm. long, persistent; leaflets 4- to 5-jugate; glands sessile, sometimes reduced or obsolete; petiolules 4 to 6 mm. long; blades elliptic to ovate-lanceolate, obtuse-acuminate, coriaceous, reticulate, 5 to 17 cm. long, 2 to 6 cm. broad. Inflorescences mostly terminal and paniculate; peduncles glabrous, 3 to 7.5 cm. long. Flowers pedicellate; bractlets subulate, pubescent, shorter than the pedicels, these glabrous, 1 to 2 mm. long; calyx tubulous, 1 to 2.5 mm. long, more or less pubescent; corolla glabrous, tubulous-campanulate, 3.5 to 7.5 mm. long; stamen tube inclosed; ovary glabrous. Legume pedunculate, long stipitate (the stiplets inserted laterally), rounded at the apex, glabrescent, 9 to 12 cm. long, 4 to 5 cm. broad.

Specimens examined:

MEXICO: Oaxaca, alt. 1650 meters, flowers April 9, 1894, *Purpus*.

GUATEMALA: Barberena, Department of Santa Rosa, alt. 1,000 meters, flowers July 1893, *Heyde & Lux* (J. D. Smith, No. 3280). San Miguel Uspantán, Department of Quiché, alt. 2,000 meters; flowers April 1892, *Heyde & Lux* (J. D. Smith, No. 3309). Cuajiniquilapa, Department of Santa Rosa, alt. 350 meters, flowers November 1893, *Heyde & Lux* (J. D. Smith, No. 6122). Chinautla, Department of Guatemala, alt. 1,300 meters, flowers May 1892, *J. D. Smith* 2819.

COSTA RICA: Alajuela, alt. 900 meters, flowers March 1896, *J. D. Smith* 6490. Near San José in coffee plantations, flowers April 6, 1903, *Cook & Doyle* 15.

10. **Inga radians** Pittier, Contr. U. S. Nat. Herb. **18**: 178. 1916. (Pls. XV, XVI, XVII, XVIII, XIX.)

A tree; branchlets subangulous, the young shoots more or less ferruginous-pubescent. Rachis of the leaves remotely puberulous or glabrous, 10 to 14 cm. long, the petiolar part 1.5 to 4 cm. long; stipules obovate, glabrous, persistent, about 1.5 cm. long; leaflets 3 or rarely 4-jugate, petiolulate; glands stipitate, often reduced to the basal one or all obsolete; petiolules 5 mm. long; blades elliptic to ovate, rounded or subcuneate at the base, long acuminate, glabrous, 7 to 8 cm long and 4 to 7.5 cm. broad. Inflorescences 1 to 3 in the axils of the upper leaves; peduncles 8 to 12 cm. long, loose, striate, sparsely puberulous; bractlets naviculiform, caducous, about 2 mm. long; pedicels about 2 mm. long, glabrous or sparsely puberulous; calyx 2.3 mm. long, sparsely pubescent; corolla tubulous-funnelform, 8 to 8.5 mm. long, the lobes 1.5 to 2 mm. deep, with the tips rounded, inflected inside, minutely puberulous; stamen tube hardly exserted; ovary glabrous, elongated; style as long as the stamens. Legume pedunculate, rounded at the base, obtuse at the apex, glabrous, about 40 cm. long and 3 cm. thick, 6.5 to 8.5 cm. broad, the margins thick, 1.2 to 1.5 cm. broad; seeds about 15, ovoid oblong, slightly depressed, surrounded with a white sweet pulp.

Specimens examined:

Mexico: Tapachula, Chiapas, in coffee plantations, flowers April 26, 1902, *Cook*, 805; type, Oaxaca, alt. 1650 meters, flowers December 1900, *Conzatti & González* 1146.

Section 3. BOURGONIA

Flowers small, glabrous or sparsely puberulous or pubescent, sessile or very short pedicellate on a loose, slender, more or less pubescent rachis. Corolla funnelform or campanulate, about four times longer than the very small calyx. Legume flat or rounded glabrous, more or less broad, narrowly marginate. Rachis of the leaves canaliculate, marginate or narrowly winged; glands sessile, small, pertuse.

Rachis of the leaves winged or, rarely, marginate; leaflets elliptic to ovate-lanceolate, long-acuminate; legume narrow (1 to 1.7 cm. broad) 11. *I. marginata.*

Rachis of the leaves marginate; leaflets ovate or obovate, more or less obtuse; legume about 2.5 cm. broad 12. *I. laurina.*

11. **Inga marginata** Willd, Sp. Pl. **4**: 1015. 1806.

A middle-sized tree. Leaves glabrous; rachis 2.5 to 5 cm. long, rarely marginate, usually winged, the wings very narrow below the first pair of leaflets, broader below the terminal pair; leaflets usually 2-jugate, coriaceous or membranous, short-petiolulate, lanceolate or oblong-lanceolate, long-acuminate, 6 to 12 cm. long, 2 to 4 cm. broad. Flower spikes axillary or terminal, solitary or fasciculate, 5 to 10 cm. long, not very dense; flowers sessile of subsessile; calyx 1.5 mm. long, pubescent at the base; corolla white, campanulate, about 4 mm. long; stamen tube long-exserted. Legume sessile, thickened around the seeds, 5 to 12 cm. long, 1.7 cm. broad.

Type from Caracas, Venezuela.

Specimens examined:

Costa Rica: Atirro, Reventazón Valley, alt. 600 meters, flowers April 1896, *J. D. Smith* 6493. Vicinity of Sipurio, Talamanca, alt, about 60 meters, flowers March 1894, *Tonduz* (Inst. Fís. Geogr. 8710). Banks of the Río Tuís, Reventazón Basin, alt. 650 meters, flowers October 1897, *Tonduz* (Inst. Fís. Geogr. 11349). Buenos Aires, Diquís Valley, flowers January 1892, *Tonduz* (Inst. Fís. Geogr. 6690). Las Vueltas de Tucurrique, Reventazón Valley, flowers November 1898, *Tonduz* (Inst. Fís. Geogr. 12744). Jiménez, Llanos de Santa Clara, flowers September 1896, *Cooper* (Inst. Fís. Geogr. 10198).

PANAMÁ: Near Lion Hill railway station, in damp woods, *Hayes* 468. Lake shore along the Gatún Valley, flowers and fruits March 25, 1914, *Pittier* 6512. Boca de Pauarandó, southern Darién, fruits February 4, 1912, *Pittier* 5579. Bismarck, above Penonomé, Province of Coclé, fruit March 15, 1908, *Williams* 600.

12. **Inga laurina** Willd. Sp. Pl. 4: 1018. 1806. (Pls. XX, XXI, XXII.)

A small tree, usually with a broad crown. Leaves glabrous or almost so; rachis marginate, 1.5 to 10 cm. long; leaflets 2 or 3-jugate, coriaceous, short petiolulate, oblique, ovate or obovate, attenuate at the base, obtuse or broadly acuminate and emarginate at the apex, 3 to 14 cm. long, 1.5 to 4.5 cm. broad. Flower spikes axillary or terminal, solitary or geminate, 4 to 15 cm. long; flowers sessile or subsessile, sweet-scented; calyx tubular, glabrous or glabrescent, 1.2 to 1.9 mm. long; corolla white, tubular-campanulate, 4 to 5 mm. long; stamen tube long-exserted. Legume 7.5 to 10 cm. long, about 2.5 cm. broad.

Type from SAINT CHRISTOPHER ISLAND, Lesser Antilles.

Specimens examined:

MEXICO: Vicinity of Acapulco, Guerrero, flowers March 1 to 10, 1895, *Palmer* 584. Hacienda de San Marcos, Jalisco, fruits June 4, 1893. *Pringle* 5494.

EL SALVADOR: Near Juayúa, Department of Sonsonate, alt. 1470 meters, flowers February 27, 1907, *Pittier* 1990.

PANAMÁ: Boca Chica de Horconcitos, western Chiriquí, *Seemann* 1689; at water edge; probably at the same locality, flowers December 15, 1911, *Pittier* 5119; Bismarck, above Panamá, Province of Coclé, flowers March 1908, *Williams* 532.

Section 4. PSEUDINGA

Flower spikes erect, at first short, becoming longer as the flowering proceeds; flowers sessile, subsessile, or rarely pedicellate. Calyx tubular, narrow, hairy or rarely glabrous. Corolla silky-villous (except in series *Glabriflorae,* not as yet reported from Central America). Legume flat, more or less thin or inflated at the seed; margins naked, rounded or more or less elevated around the sides, glabrous or hairy. Petioles naked or winged. Glands often obsolete; flower spikes often axillary, or corymbose or paniculate at the ends of the branches.

Series a–*Gymnopoda* Benth.

Corolla densely silky-pubescent or villous, rarely sparsely strigose; calyx tubular, pilosulous or pubescent; bracts small, caducous; glands sessile or nearly so, or obsolete; petiole usually naked or narrowly marginate.

Flowers short-pedicellate; branchlets and leaves glabrous; peduncles and pedicels pilosulous; leaflets 3- 4-jugate 13. *I. brevipedicellata*
Flowers sessile
Branchlets, leaves, and peduncles more or less appressed-pubescent, or glabrescent
Leaflets 3-jugate; legume more or less stipitate 14. *I. leptoloba*
Leaflets 2-jugate, legume rounded at the base 15. *I. punctata*
Branchlets, leaves, and peduncles more or less ferruginous-hairy
Leaflets obovate, 2-jugate 16. *I. pinetorum*
Leaflets ovate-elliptic or lanceolate, 4 to 10-jugate
Inflorescences more or less densely paniculate at the end of the branchlets
Corolla 7 to 9 mm. long; rachis of the leaves thick, angular; leaflets elliptic-oblong or obovate, 4-8-jugate 17 *I.. ruiziana*
Corolla 18 mm. long; rachis of the leaves terete; leaflets lanceolate, long acuminate, 5-6-jugate 18. *I. Recordii*
Inflorescences not paniculate, the peduncles solitary or few clustered in the axils of the leaves, these with slender rachis

Leaflets 5- or 6-jugate, pubescent beneath; flower spikes solitary or geminate; calyx 7 mm. long; corolla 18.5 mm. long
19. *I. aestuariorum*

Leaflets 5 to 10-jugate, puberulous on both sides; flower spikes 3 to 5-clustered; calyx 6 mm. long; corolla 23 to 25 mm.
20. *I. multijuga*

13. **Inga brevipedicellata** Harms, Repert. Sp. nov. **19**: 62. 1923.*

A tree, the branchlets grayish. Leaves small, glabrous, the rachis wingless, angulous, 8–15 cm. long including the petiolar part 2.5–3.5 cm. long; leaflets 3-4-jugate, very shortly petiolulate, oblong to oblong-lanceolate, short acuminate and glabrous. Inflorescences pedunculate, 1 to 3 in the axils of the leaves; peduncles pilosulous, 6–8 cm. long including the rachis; flowers numerous, small, short pedicellate, the pedicels 2 mm. long, pilosulous; calyx 3 mm. long, funnelform, puberulous; corolla appressed pilose, 5 to 6 mm. long.

MEXICO: Type from Mirador, Veracruz, alt. 1,000 m.; fl. Febr. 1921 and 1922 (*J. A. Purpus* 282); Zacuapan, Veracruz (*Purpus* 3675).

14. **Inga leptoloba** Schlecht. Linnaea **12**: 559. **1888.** (Pls. XXIII, XXIV, XXV.)

A tree of middle or small size. Branchlets slender, terete, glabrous or minutely appressed-pubescent, covered with minute lenticels. Leaves rather small, more or less pubescent or puberulous, sometimes glabrous; stipules sparsely hairy, 3 to 4 mm. long, subulate, caducous; rachis distinctly marginate between the leaflets, or sometimes subterete, more of less appressed-pubescent, 4 to 10 cm. long, the petiolar part 1.5 to 3 cm. long; leaflets 3-jugate, petiolulate, coriaceous; glands obsolete, or apparent and then small or large, prominent or immersed, almost always pertuse; petiolules 1 to 5 mm. long, pubescent or almost glabrous; leaflet blades more or less oblique, ovate-elliptic or lanceolate, usually cuneate or sometimes rounded at the base, obtuse, obtusely or acutely acuminate but nearly always mucronate at the apex, sparsely covered with appressed hairs on both sides, above lustrous, with the costa and veins slightly prominent, beneath paler or brownish, with the costa and veins prominent and more or less pubescent, the blades of the basal pair of leaflets 3.5 to 10.5 cm. long and 1 to 4.5 cm. broad, those of the terminal pair 9 to 17 cm. long and 2.7 to 7 cm. broad. Inflorescences axillary, the spikes then 2 to 7 or more together, or terminal and paniculate, the spikes then either in fascicles of 2 to 4 or more in the upper axils, or borne on axillary defoliate shoots; spikes 2 to 6 cm. long, the peduncles angular, 1.5 to 5 cm. long, more or less appressed-pubescent, the rachis very short and pubescent; bractlets subulate, densely pubescent, less than half as long as the calyx; flowers sessile; calyx tubular, the upper part slightly broadened, 4.4 to 6 mm. long, more or less pubescent, the teeth irregularly cleft and acute; corolla tubular-funnelform, 6.5 to 10 mm. long, silky-villous, the lobes lanceolate, about 2 mm. long; stamen tube equalling the corolla or slightly exserted; ovary glabrous; style capitellate. Legume flat, more or less cuneate and stipitate at the base, abruptly and obliquely acuminate at the apex, the margins appressed-pubescent, thick and prominent around the faces, 2 to 2.3 cm. broad, 5 to 18 cm. long: seeds 3 to 20, immersed in a thin pulp.

Specimens examined:

Mexico: Hacienda de la Laguna, near Jalapa, Veracruz, alt. about 1,400 meters, *Schiede:* probably the type collection, in Gray Herbarium. Wartenberg, near Tantoyuca, Veracruz, April 1858, *Ervendberg* 4. Córdoba Valley, Veracruz, March 4 and May 6, 1866, *Bourgeau* 2043, 2320. Outskirts of Tuxtepec, Oaxaca, flowers April 9, 1894, *Nelson* 377. Coatzacoalcos, Veracruz, flowers April 16, 1895, *C. L. Smith* 987, 1146. Between San Juan Bautista and Atasta, Tabasco, flowers March 14, 1888, *Rovirosa* 128. Without locality, *Kerber* 403.

Guatemala: Setzimaj, Alta Verapaz, flowers March 19, 1902. *Cook & Griggs* 51, 52, 53. Sepacuité, Alta Verapaz, flowers April 7 and 17, 1902, *Cook & Griggs* 491, 636. Las Viñas, Santa Rosa, flowers September 1893, *Heyde & Lux* (J. D. Smith, No. 6094.)

Honduras: San Pedro Sula, Santa Barbara, flowers March 1890, *Thieme* (J. D. Smith, No. 5209).

El Salvador: Vicinity of San Salvador, Renson 238.

Costa Rica: San José, common in hedges and pastures, fruits May 1888, *Pittier* (Inst. Fís. Geogr. 233); flowers September 14, 1889, *Tonduz* (Inst. Fís. Geogr. 1417). Along Río Ciruelas, near Barba, flowers March 15, 1890, *Biolley* (Ins. Fís. Geogr. 3230). Along Río Torres, near San José, flowers and fruits November and December, 1895, *Tonduz* (Inst. Fís. Geogr. 8010, 9793). Banks of Río Tibás, near San Juan, flowers January 1913, *Jiménez* 821. Forests of El Palmar de Boruca, Diquís Valley, fruits April 18, 1892, *Tonduz* (Inst. Fís. Geogr. Costa Rica, No. 6756).

Panamá: El Boquete de Chiriquí, Seemann 1690.

As has been stated elsewhere[1] by the writer, *Inga leptoloba* differs from *Inga punctata*, in its 3-jugate leaflets, these usually narrow and cuneate at the base, and in its narrower and fuller legumes, which besides, are almost always stipitate or at least cuneate at the base. These two species are often hopelessly confused in herbaria, and it must be admitted that at times, it is difficult to distinguish the two species.

15. Inga punctata Willd. Sp. Pl. 4:1016. 1806.

A tree. Branchlets subangular or almost terete covered with whitish punctiform lenticels. Leaf rachis terete, glabrescent or sparsely covered with short appressed hairs, 3 to 5.5 cm. long, the petiolar part 1.5 to 2 cm. long; leaflets 2-jugate, rarely 3-jugate, short-petiolulate; glands small, sessile, depressed or rounded, sometimes obsolete; petiolules pubescent, 1 to 2 mm. long; leaflet blades oblique, oblong or elliptic-lanceolate, short-cuneate at the base, acuminate at the apex, mucronate, sparsely pubescent on both faces, lustrous above, with the costa and veins slightly prominent, beneath paler, with the costa and veins strongly prominent, the blades of the lower pair of leaflets 7 to 7.5 cm. long and about 3 cm, wide, those of the upper pair 12 to 13 cm. long (4 inches, or about 10 cm., according to Bentham) and 4 to 5 cm. broad; stipules subulate, 6 to 7 mm. long. Inflorescences axillary, the spikes 1 to 4-clustered, about 3 cm. long; peduncles angular, sparsely pubescent, 1 to 2 cm. long; flowers sessile; calyx tubular but broadening toward the apex, grayish-pubescent, 2.7 to 3.4 mm. long, the teeth irregular; corolla tubular-funnelform, silky-villous, 6.6 to 7.5 mm. long (3 lines, or 6.3 mm. long according to Bentham), the lobes 1.5 to 2 mm. long, rather broad; stamen tube slightly exserted. Legume rounded at the base, often abruptly substipitate, 15 cm. long or over, about 2.5 cm. broad, at first pubescent, glabrous in age, depressed, the margins slightly elevated.

Specimens examined:

MEXICO: Tapachula, Chiapas, a shade tree, flowers November 12, 1918, *Popenoe* 814.

GUATEMALA: Cubiquiltz, Alta Verapaz, alt. 350 meters, flowers March 1902; *Turckheim* (J. D. Smith, 8195.) Morales, Department of Izabal, flowers March 1907, *Kellerman* 6109. San Francisco de Miramar, Costa Cuca, fruits April 1905, *Pittier* 68.

COSTA RICA: Along Amóura River, near Xirores, Talamanca, in forests, flowers February 1895, *Tonduz* (Inst. Fís. Geogr. 9354,

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[1] Contr. U. S. Nat. Herb. 18: 188. 1916.

9355). Plains of San Carlos, in open field by creek, flowers April 15, 1903, *Cook & Doyle* 92. Turrialba, in pastures, flowers November 1893, *Tonduz* (Ins. Fís. Geogr. Costa Rica, No. 8303).

PANAMÁ: Along Río Culebra, above Santa Isabel, province of Colón, flowers and fruits August 10, 1911, *Pittier* 4161.

15 *a*. **Inga punctata chagrensis,** Pittier, subsp. nov.

A tree, 6 to 8 meters high. Branchlets subangular or almost terete, with or without white lenticels, the younger growth appressed-pubescent. Leaves larger than in the species; rachis submarginate, appressed-pubescent, 2 to 7 cm. long, the petiolar part 1 to 3 cm long; stipules setaceous, pubescent, caducous, about 8 mm. long; leaflets 2-jugate, petiolulate; glands usually large, sessile, orbicular, mostly flat, sometimes concave; petiolules pubescent, 2 to 3 mm. long; leaflet blades suboblique, elliptic-ovate to elliptic-lanceolate, attenuate and rounded at the base, acutely acuminate and mucronate at tip, sparsely appressed-pubescent on both surfaces, lustrous and darkish above, paler beneath, the costa and veins densely pubescent on both faces and prominent, but more so beneath, the blades of the lower pair 5 to 10.5 cm. long, 1.5 to 4 cm. broad, those of the upper pair 7 to 16 cm. long, 2 to 6 cm. broad. Inflorescences paniculate, the branchlets forming the common peduncle axillary or terminal; flower spikes in clusters of 2 to 5 on defoliate axils; peduncles angular, appressed-pubescent, about 3 cm. long; rachis pubescent 1 to 1.7 cm long; bractlets oblanceolate and naviculiform, pubescent, 2.5 mm. long, very caducous; flowers sessile; calyx tubular, narrow and slightly broadened toward the tip, 5.1 to 5.6 mm. long; corolla silky-villous, tubular-funnelform, 9.5 to 10.6 mm. long, the lobes narrow, about 2.7 mm. long; stamen tube slightly exserted. Legume subsessile, more or less arcuate, the sides flattened and transversely grooved between the seeds, rounded at the base, rounded and mucronate or abruptly acuminate at the tip, glabrescent, 9 to 12 cm. long, 18 to 20 mm. broad, the margins distinctly elevated around the broad sides; seeds 8 to 14.

Type in the U. S. National Herbarium No. 675176, collected on the banks of the Chagres River, Canal Zone, Panamá, flowers and fruits February 14, 1911, by *William R. Maxon* (No. 4788). Additional specimen examined:

PANAMÁ: Gatún, Canal Zone, fruit February 10, 1911, *Goldman* 1865.

15 *b*. **Inga punctata panamensis** Benth. Trans. Linn. Soc. **30**: 613. 1875.

Branchlets terete or subangular, the bark covered with minute white lenticels; young shoots sparsely appressed pubescent, 3.5 to 4.5 cm. long, the petiolar part 2 cm. long; leaflets petiolulate; glands suburceolate, small, salient, pertuse, sometimes obsolete; petiolules pubescent, 2 to 3 mm. long; leaflet blades ovate-elliptic, oblique, cuneate or rounded-attenuate at the base, acuminate at the apex, mucronate, sparsely hairy on both faces, with the costa and veins prominent and pubescent, the blades of the lower pair 5 to 7.5 cm. long, 2 to 3.5 cm. broad, those of the terminal pair 7.5 to 11 cm. long, 3 to 4 cm. broad. Legume (immature) subsessile, abruptly long-acuminate, 6 to 7 cm. long, 18 mm. wide, the prominent margin densely pubescent.

Specimens examined: Panamá; Chagres, Province of Colón, young fruit February 15, 1850, *Fendler* 89.

The specimen in the Gray Herbarium, on which the above description is based, is of the type collection of this variety. It differs from *I. punctata chagrensis* in the shape and size of the leaflets, and in the glands, these being suburceolate, rather than flat and orbicular, and pertuse.

In other specimens, enumerated below and which I consider as representing the same variety, the leaflets are often much larger (up to 21 cm. long and 8.5 cm. broad), the glands are either as described above or obsolete, and the inflorescences are paniculate as in *Inga punctata chagrensis*, with which it agrees also in the other characters of the floral spikes. The flowers however, are distinctly smaller, the calyx being 3.4 to 5.5 mm. long and the corolla 6.7 to 10.5 mm. long.

The mature pod of *Pittier* 4161 is 10.5 cm. long and 2 cm. wide, and hardly differs from those of Subsp. *chagrensis*.

Specimens examined:

BRITISH HONDURAS: Forests near Manatee Lagoon, flowers and young fruits February 8, 1906, *Peck* 334.

PANAMÁ: Cerro Gordo, near Culebra, Canal Zone, immature fruits January 10, 1911, *Pittier* 2309.

16. **Inga pinetorum** Pittier, Contr. U. S. Nat. Herb. **18**: 185. pl. 90. 1916.

A tree. Rachis of the leaves terete, ferruginous-pubescent, 2.5 to 3.5 cm. long; glands very small, urceolate; leaflets 2-jugate, the the petiolules 3 mm. long, the blades obovate, cuneate at the base, subobtuse and mucronate or sometimes acuminate at the apex, 4 to

12 cm. long, 2 to 5 cm. broad, puberulous; costa and veins pubescent, the former prominent and the latter impressed above, both prominent beneath. Floral spikes axillary, geminate, the peduncles ferruginous hairy, 5 to 6.5 cm. long; flowers sessile; calyx tubulous, stipitate, sparsely hairy, about 7 mm. long; corolla tubulous, broadening toward the apex, about 11.5 mm. long, silky villous, the lobes nearly 3 mm. long, narrow and acute; stamen tube slightly exserted; ovary glabrous, stipitate. Legume not known.

BRITITH HONDURAS: Pine ridge near Manatee Lagoon, flowers February 19, 1906, *Peck* 343; Type in Gray Herbarium.

17. **Inga ruiziana** G. Don. Gen. Hist. Dichl. Pl. **2**: 391. 1832.

A medium-sized tree, with flat, densely foliate crown; branchlets often minutely pubescent, covered with white, elongate lenticels. Leaves more or less pubescent, the rachis thick, rusty-colored, angular or marginate, 10 to 28 cm. long; glands sessile, orbicular: leaflets 4, 5, 6, and often 7 or 8-jugate, short petiolulate, elliptic-oblong or obovate, more or less rounded at the base, short acuminate and acute at the apex, sparsely ferruginous pubescent on both sides on the costa and veins, these very prominent beneath; petiolules 2 to 4 mm. long; blades prominent beneath; petiolules 2 to 4 mm. long; blades often lustrous above, 5 to 23 cm. long; 2.5 to 7 cm. broad, those of the terminal pair larger. Flower spikes solitary or 2 to 4-clustered in the axils of the upper leaves, or paniculate at the defoliate ends of the branchlets; flower heads broadly ovate; peduncles brownish-tomentose, 2 to 4 cm. long; bracts linear, about 1.5 cm. long and 2 mm. broad, caducous; flowers subsessile; calyx pubescent, 2.5 to 4 mm. long, the teeth acute and very short: corolla silky pubescent, 7 to 9 mm. long, the lobes broad, about 2 mm. long. Legume 8 to 13 cm. long, 2.5 to 4 cm. broad, flat, the margin elevated around the sides and acutely ridged; seeds 12 to 15.

Type from Perú.

Specimens examined:

NICARAGUA: San Juan del Norte, February 18, 1896, *C. L. Smith* 7.

COSTA RICA: Xirores, Talamanca, in forests, flowers and fruits February 1895, *Tonduz* (Inst. Fís. Geogr. 9356). Vicinity of Port Limón, flowers October 4, 1895, *Tonduz* (Inst. Fís. Geogr. 9801). Las Vueltas de Tucurrique, Reventazón Valley, in pasture, flowers and fruits April 26, 1899, *Tonduz* (Inst. Fís. Geogr. 13054). Juan Viñas, Reventazón Valley, in coffee-plantations, flowers and fruits April 26, 1903, *Cook & Doyle* 391.

PANAMÁ: Near Marragantí, southern Darién, fruits, April 8, 1908, *Williams* 768. Along Sambú River, southern Darién, flowers and fruits February 7, 1912, *Pittier* 5533. Banks of Río Fató, near Nombre de Dios, Province of Colón, in forest, flowers, July 9, 1911, *Pittier* 3917. Valley of Masambí, on the road to Las Cascadas plantation, Canal Zone, fruits February 6, 1911, *Pittier* 2674. Gamboa, Canal Zone, flowers and fruits March 29, 1914, *Pittier* 6520.

Britton & Rose (North Amer. Flora, 23, 1:5) consider the collections placed here as belonging to a distinct species which they call *I. confusa*, giving my No. 5533 as type. I have not seen the type of *I. ruiziana*, but the specimens enumerated under this head agree so well with Bentham's description in the Flora brasiliensis (15, 2: 479) that I hesitate to accept the view of the botanists of the North American Flora.

18. **Inga Recordii** Britton & Rose, Trop. Woods 7: 5. 1926.

A medium-sized tree with puberulent branchlets; rachis of the leaves wingless, pubescent, the petiolar part 1 to 2 cm. long; glands large, cup-shaped; leaflets 5- to 6-jugate, lanceolate, long-acuminate, 5–13 cm. long, lustrous and more or less pubescent above, pale and appressed-pubescent beneath; spikes axillary or paniculate at the end of the branchlets, the peduncles 1–2 cm. long; floral bractlets very small; calyx appressed-pubescent, 4–5 mm. long; corolla slender, silky-pubescent, 18 mm. long; stamen tube inclosed, 3 cm. long; ovary terete, densely lanate.

BRITISH HONDURAS: Stann Creek District; flowers January 19, 1926 (*J. Record*, type).

GUATEMALA: Near Entre Ríos, río Motagua Valley; flowers March 1, 1926 (*J. Record* No. 40; wood sample in Yale collection 8871).

In the opinion of the authors, this species, which I have not seen, would be related to *Inga laurina*, a very characteristic member of Sect. *Bourgonia*, and at the same time with *I. Standleyana*, very distinct of this in habit, indumentation, shape of the flowers and of the fruit, which I have placed among the Pseudingæ-Dysanthæ. At the same time, it is incorporated, in the key of the North-American Flora (23, 1: 2), in a group which includes, besides the three species mentioned, I. *æstuariorum*, which I have placed among the Pseudingæ-Gymnopodæ. I have to confess that I cannot see but very distant affinities between these four species. From the description, I think that *I. Recordii* can be safely placed in the Gymnopodæ, near the last-named species.

19. **Inga aestuariorum** Pittier, Contr. U. S. Nat. Herb. **18**: 183. pl. 89. 1916.

A low bushy tree. Rachis of the leaves slender, 9 to 15 cm. long, terete or subangulous; glands prominent, sessile, cup-like; leaflets 5 to 6-jugate, coriaceous, the petiolules very short, the blades ovate to ovate-elliptic, broadly rounded at the base, obtuse or subacute and mucronate at the apex, pilosulous and often lustrous above, reticulate and sparsely pubescent beneath, 3 to 12 cm. long, 2 to 4.5 cm. broad, the costa densely pubescent and prominent beneath. Floral spikes axillary, single or geminate, the peduncles densely ferruginous-pubescent, 3 to 5 cm. long, the flowerheads loose and elongate; flowers sessile; calyx striate, pubescent, 7 mm. long, the teeth very short; corolla white, 18.5 mm. long, silky villous, the lobes narrow, about 2.5 mm. long; stamen tube briefly exserted, the stamens pink. Legume sessile, rounded at the base, apiculate, 14 to 20 cm. long, the faces glabrescent, 1.7 cm. broad, surrounded by the surelevated, densely ferruginous-pubescent margins; seeds about 10.

Specimens examined:

COSTA *Rica*: Boca Zacate, Diquís Delta, in the tide belt of the Pacific coast, flowers and fruits April 1892, *Tonduz* (Inst. Fís. Geogr. Costa Rica 6793). Laguna de Sierpe, *Pittier.*

20. **Inga multijuga** Benth. Trans. Linn. Soc. **30**: 615. 1875.

A small or middle-sized tree; branchlets ferruginous-pubescent, more or less densely dotted with minute white lenticels. Leaves more or less ferruginous-pubescent, the rachis slender, slightly marginate, 18 to 26 cm. long; glands small, subsessile, often laterally compressed; leaflets coriaceous, 5 to 10-jugate, short petiolulate (petiolules about 3 mm. long), ovate or oblong to ovate-elliptic, rounded and almost cuneate at the base, acute or acuminate at the apex, puberulous and lustrous above, pubescent and pale brown beneath, 4 to 17 cm. long, 1.5 to 6 cm. broad, those of the basal pair smallest, the costa and veins very prominent beneath. Flower spikes axillary, 2 to 5-clustered, the flower heads ovoid, calyx pubescent, 5 to 7 mm. long; corolla silky-villous, 23.5 to 25 mm. long. Legume not known.

Specimens examined:

GUATEMALA: Chirujijá Oxec, Alta Verapaz, flowers April 1902, *Cook & Griggs* 641, 729, 734, 739. Cubilquitz, Alta Verapaz, flowers March 1913, *Türckheim* (J. D. Smith 4090).

PANAMÁ: Lion Hill railway station, Canal Zone, *Hayes* 645; type collection.

Fendler's No. 51, collected in flower at Chagres, Province of Colón, January 24, 1850, and cited by Bentham under *I. multijuga*, evidently does not belong here. The leaves and inflorescences are very distinct, and the calyx and corolla are much broader, being respectively about 4.5 and 15 mm. long. The specimen in the Gray Herbarium looks rather like a large-flowered form of *I. ruiziana*.

Series b – *Pilosiusculæ* Benth.

Rachis of the leaves winged between the pairs of leaflets. Glands large or small, flat or urceolate, sessile or subsessile. Bractlets caducous, very small and ovate, or large (sometimes longer than the calyx) and then linear or subulate. Flowers sessile; calyx tubular, hairy, villosulous, sparsely pubescent or almost glabrous; corolla densely silky villous, villosulous, or pubescent. Legume, where known, broad, the margin slightly elevated around the faces.

Leaflets 2 or 3-jugate; peduncles 2 cm. long or less.
  Leaflets glabrous except on the costa and veins; flowers rather large, the corolla 16 mm. long or over
  21. *I. Hayesii.*
  Leaflets sparsely pubescent above, fulvous-tomentose beneath; flowers small, the corolla not over 14.5 mm. long
  22. *I. Tuerckheimii.*
Leaflets 3 or 5-jugate; peduncles 3 cm. long or more.
  Leaflets glabrous except on the costa and veins; flower spikes solitary in the axils; glands large, flat, subpeltate
  23. *I. monticola.*
  Leaflets more or less hairy; flower spikes mostly clustered in the axils, glands very small and often obsolete
    Leaflets and younger parts more or less ferruginous-tomentose.
      Calyx sessile, the teeth acute; corolla 11.5 to 13 mm. long, densely rufous-villosulous; leaflets 3-jugate
      24. *I. cobanensis.*
      Calyx stipitate, the teeth rounded; corolla 8.5 to 10 mm. long, villous; leaflets 4 or 5-jugate
      25. *I. mollifoliola*
    Leaflets puberulous or sparsely villosulous.
      Leaflets mostly 5-jugate, elliptic, acuminate; bractlets linear, 4 to 7 mm. long, calyx sparsely hairy
      26. *I. Pringlei.*
      Leaflets 4-jugate, oblong, obtuse; bractlets ovate, less than 1 mm. long; calyx densely hairy
      27. I. *micheliana.*

21. **Inga Hayesii** Benth. Trans. Linn. Soc. **30**: 617. 1875.

A small tree, the branchlets terete, reddish, lenticellose, the younger parts more or less brownish-villous. Rachis of the leaves sparsely hairy, 5 to 11.5 cm. long, broadly winged; stipules obovate, pubescent without, 3 to 4 mm. long, caducous; leaflets 2 or 3-jugate, short petiolulate; petiolules very short, pubescent; blades ovate to lanceolate, rounded and subemarginate at the base, obtuse to acute at the apex, glabrous except on the costa and veins, 3.5 to 14 cm. long, 1.5 to 6 cm. broad. Inflorescences axillary, subsessile; bractlets pubescent, much shorter than the calyx, deciduous; calyx about 7.5 mm. long, striate, glabrous or subglabrous; corolla white, villous, about 16.3 mm. long, the lobes 3.5 to 4 mm. long; stamen tube inclosed; ovary sessile, glabrous, 6-ovulate; style equal to the stamens (about 4 cm. long from base), capitellate. Legume not known.

Type collected in Panamá by Hayes.

Specimens examined:

PANAMÁ: Hills around the Agricultural Experiment Station at Matías Hernández, near Old Panamá, flowers July 10, 1914, *Pittier* 6714.

22. **Inga Tuerckheimii** Pittier. Contr. U. S. Nat. Herb. **18**: 192. 1916.

A tree, the branchlets subangulous, covered with numerous white lenticels, the younger parts, rachis of the leaves and peduncles ferruginous-pubescent. Rachis of the leaves winged between the leaflets, 3.5 to 6 cm. long; glands small, irregularly shaped, substipitate; leaflets 3-jugate, coriaceous, the petiolules about 3 mm. long, the blades ovate, oblong or ovate-lanceolate, acute, 2.5 to 11 cm. long, 1 to 5.5 cm. broad, sparsely pubescent or glabrescent above, fulvous-pubescent, strongly veined and reticulate beneath, the costa and veins ferruginous-pubescent, the former impressed on the upper face of leaflet. Floral spikes in clusters of 4 to 5 in the upper axils, the peduncles 1 to 2 cm. long; bractlets ovate-lanceolate, 3 to 5 mm. long, pubescent, caducous; flowers sessile; calyx densely ferruginous-pubescent, 5.5 to 6.5 mm. long; corolla 12 to 14.5 mm. long, broader at the apex, ferruginous-pubescent; stamen tube inclosed; ovary sessile, depressed laterally. Legume not known.

Specimen examined:

GUATEMALA: Cobán, Alta Verapaz, alt. 1,450 meters, flowers April 1887, *Türckheim* (*J. D. Smith*, 1214, type).

23. **Inga monticola** Pittier, Contr. U. S. Nat. Herb. **18**:190. *pl. 96.* 1916.

A spreading tree, 16 m. high, the branchlets terete, lenticellous, the younger parts ferruginous-pubescent. Rachis of the leaves narrowly winged, ferruginous-pubescent, 5.5 to 10 cm. long; leaflets mostly 4-jugate or less, the petiolules pubescent, 1 mm. long or less, the blades oblique, membranous, oblong or ovate-elliptic, rounded at the base, acute or short acuminate, glabrous and lustrous above, glabrous or sparsely hairy and reticulate beneath, 4 to 14.5 cm. long, 1.5 to 5.5 cm. broad, the costa and veins pubescent on both faces. Floral spikes single in the axils of the upper leaves, the peduncles ferruginous-pubescent, 3 to 4 cm. long; bractlets lineal, 1 to 3 mm. long; calyx substriate, minutely puberulent, 4.1 to 4.3 mm. long; corolla 7 to 8 mm. long, funnelform, minutely pubescent, the lobes about 1.5 mm. long; stamen tube inclosed. Legume 8 to 16 cm. long, 5 cm. broad, rounded at the base, acuminate, the faces glabrous, blackish, transversally grooved, the margin ferruginous-pubescent; seeds 5 to 10.

Specimen examined:

PANAMÁ: Bismark above Penonomé, Province of Coclé, flowers and fruits March 6, 1908, *Williams* 316; type.

24. **Inga cobanensis** Pittier, Contr. U. S. Nat. Herb. **18**:188. 1916.

A tree, the pubescence ferruginous or rufous all over. Rachis of the leaves wingless on the petiolar part, winged between the leaflets, the glands small, sessile; leaflets 3-jugate, the petiolules hairy, up to 2 mm. long, the blades ovate, rounded at the base, acute or subacuminate, 3 to 11 cm. long, 1.5 to 5.5 cm. broad, glabrous above except on the pubescent venation, reticulate and tomentose beneath. Floral spikes 3 to 6 in the axils of the upper leaves, the peduncles densely pubescent, 1 to 3 cm. long, the flower heads elongate and many flowered; bractlets lineal hairy, shorter than the calyx; flowers sessile; calyx densely pubescent, 4.3 to 6.3 mm. long, the teeth short and acute; corolla 11.6 to 13.2 mm. long, villous, the lobes ovate-lanceolate, acute, 1.5 to 2 mm. long; stamen tube usually inclosed, the filaments about 3 cm. long from base of tube; ovary sessile, glabrous, flattened; style about 4.5 cm. long. Legume not known.

Specimen examined:

GUATEMALA: Cobán, Alta Verapaz, alt. 1450 meters, flowers April 1887, *J. D. Smith,* 1214, type.

25. **Inga mollifoliola** Pittier, Contr. U. S. Nat. Herb. **18**: 189. 1916.

A tree, the branchlets terete, glabrous, lenticellous, the younger part ferruginous-tomentose. Rachis of the leaves narrowly winged, densely ferruginous-tomentose, 4.5 to 9.5 cm. long; stipules lanceolate, sparsely hairy, about 5 mm. long; glands small, sessile, often obsolete; leaflets 4 to 5-jugate, short-petiolulate, membranous, oblique, elliptic-ovate or oblong, narrow and rounded at the base, acuminate, glabrous and lustrous above, softly ferruginous-tomentose beneath, 3.5 to 12 cm. long, 1 to 4 cm. broad, the costa and veins densely hairy and prominent beneath. Floral spikes single or 2 or 3-clustered in the upper axils, the peduncles densely ferruginous-pubescent, 2.5 to 4.5 cm. long; bractlets lineal or subulate, hairy, 3 to 4 mm. long: calyx more or less stipitate, 5 to 6 mm. long, coarsely pubescent; corolla 8.5 to 10 mm. long, villous, the lobes about 2 mm. long; stamen tube inclosed. Legume not known.

Specimen examined:

COSTA RICA: Rodeo de Pacaca, near San José, in forest, flowers January 1891, *Pittier* (Inst. Fís. Geogr. 3251, type). San Marcos de Dota, in forest, flowers March 1893, *Tonduz* (Inst. Fís. Geogr. 7548).

26. **Inga Pringlei** Harms, Repert. Sp. nov. **13**: 526. 1915.

A small tree; branchlets angular, velvety-villous, lenticellous. Rachis of the leaves more or less narrowly winged, ferruginous-hairy, 7 to 10 cm. log; leaflets mostly 5 sometimes 4-jugate, briefly petiolulate; glands very small, subsessile, pertuse; petiolules 1 mm. long; blades ovate to oblong-lanceolate, usually rounded at the base, acute, glabrescent above, paler and puberulous beneath, 2.5 to 3 cm. broad. Inflorescences single, geminate or ternate, axillary or terminal, the peduncles ferruginous-hairy, 4 to 6 cm. long, the flower heads elongate and dense; bractlets lineal, 4 to 7 mm. long; calyx slightly striate, sparsely and briefly ferruginous-hairy, 5 to 6 mm. long; corolla appressed-villous, 6 to 9 mm. long; stamen tube inclosed. Legume not known.

Specimen examined:

MEXICO: Near Jalapa, State of Veracruz, at an altitude of 1330 meter, flowers April 11, 1899 (*Pringle* 8125, type).

27. **Inga micheliana** Harms. Repert. Sp. nov. **13**: 525. 1915.

A tree; branchlets terete or subangular, densely ferruginous-hairy. Rachis of the leaves rather broadly winged, ferruginous-hairy, 5 to 9 cm. long; leaflets mostly 4-jugate, subsessile; glands very small, subsessile, pertuse; blades oblong to lanceolate, obtuse, glabrescent above, sparsely villous beneath, 4 to 10 cm. long, 1.5 to 3.5 cm. broad. Inflorescences axillary, geminate; peduncles 3 to 4.5 cm. long, densely ferruginous-villous; flowers sessile; bractlets diminute, ovate, villous; deciduous; calyx densely villous, 4 to 5 mm. long; corolla densely silky-villous, 10 to 11 mm. long; stamen tube inclosed. Legume not known.

Specimen examined:

GUATEMALA: Río Negro, Department of Quiché, alt. 1200 meters; flowers March 1892. *Heyde & Luz* (J. D. Smith 3319, type).

Series e—*Calocephalae*

Rachis of the leaves winged or almost naked. Glands sessile or substipitate. Stipules and bractlets persistent. Flowers sessile, thick or slender; calyx tubular or campanulate, more or less hairy, sometimes striate; corolla silky villous. Legume large, flat or screw-twisted, glabrous or densely rufous-hairy.

Leaves glabrous or glabrescent; leaflets lustrous, bullate, usually 2-jugate, often 1-jugate; legume 30 to 60 cm. long, 7 cm. broad, glabrous, with rounded, not prominent margins 29. I. *spectabilis*.

Leaves more or less hairy. Legume seldom over 30 cm. long, either glabrous with prominent margins, or rufous-hairy, and flat or screw-twisted.

Rachis of the leaves narrowly winged below the terminal pair of leaflets only; legume glabrous

Leaves glabrescent; calyx 7 to 8 mm., corolla 13 to 15 mm. long; legume about 4 cm. broad 30. *I. panamensis*.

Leaves hairy; calyx 17 to 20 mm., corolla 29 to 32 mm. long; legume 2.5 to 3 cm. broad 31. *I. Purpusii*.

Rachis of the leaves completely winged; legume densely rufous-hispid.

Leaflets mostly 3-jugate, softly hairy above, velvety beneath; calyx 10.5 to 11 mm., corolla 23 to 23.5 mm. long; legume 5 to 6.5 cm. broad 32. *I. lindeniana*.

Leaflets mostly 4-jugate, sparsely hairy all over; calyx 14 mm., corolla 25 mm. long; legume 3 to 4.5 broad 33. *I. Goldmanii*.

28. **Inga spectabilis** Willd. Sp. Pl. **4**: 1017. 1805.

A middle-sized tree, the branchlets angular. Leaves glabrous or glabrescent; rachis 3.5 to 10 cm. long, marginate or narrowly winged; stipules narrow lanceolate or lineal, 6 to 12 mm. long; glands large, sessile; leaflets 1 to 3-jugate, sessile or almost so, coriaceous, bullate, broadly ovate to obovate, obtuse or subacute, 8 to 26 cm. long, 5 to 14 cm. broad, lustrous above, the costa, veins and venules strongly prominent beneath. Floral spikes paniculate at the end of the branchlets, the peduncles thick, 2.5 to 4 cm. long, minutely pubescent; bractlets ovate-lanceolate, pubescent; calyx broad, 7 to 8 mm. long, minutely pubescent; corolla white, 18 mm. long, silky villous. Legume glabrous, 30 to 60 cm. long, about 7 cm. broad and 2.5 to 3 cm. thick, the margins rounded, the apex obtuse; seeds 7 to 16 or more.

Type probably from Santa Marta, Colombia, from a cultivated tree.

COSTA RICA: Turrialba, flowers November 1893, *Tonduz*, October 1894, *Pittier* (Inst. Fís. Geogr. 8433, 9041); Talamaca (*Pittier*); Boruca, fruits February 1891, *Tonduz* (Inst. Fís. Geogr. 4765); Buenos Aires, Diquís basin, fruits February 1891, *Tonduz* (Inst. Fís. Geogr. 3826); Boca Culebra (*Pittier*).

PANAMÁ: Chagres, January 1850 (*Fendler*); Matachín, Canal Zone (*O. Kuntze* 1923) Hospital Grounds at Ancon, Canal Zone, fruits March, 1910 (Col. *Chas. F. Mason*); around Culebra, Canal Zone, leaves only January 15, 1911 (*Pittier* 2423); between Las Cascadas and Bas Obispo, Canal Zone, flowers July 1, 1911 (*Pittier* 3746); Bismarck, above Penonomé, Province of Coclé, fruits March 1908 (*Williams* 383, 584).

29. **Inga panamensis** Seemann. Bot. Voy. Herald 117. 1852–57.

A small tree, the branchlets slender, terete. Rachis of the leaves very narrowly winged below the terminal pair of leaflets, 4 to 8 cm. long, brownish hairy; stipules ovate, acute, 6 to 9 mm. long; glands very small, sessile; leaflets 1 to 3-jugate, petiolulate (the petiolules 4 mm. long), ovate to obovate, obtuse, glabrescent, 7.5 to 15 cm. long, 4.5 to 10 cm. broad, the costa and venules more or less hairy and prominent beneath. Floral spikes single, axillary or terminal, the peduncles striate, sparsely hairy, 1.5 to 3.5 cm. long; bractlets lineal, hairy, 1 to 1.5 cm. long; calyx broad, sparsely hairy, 7 to 8 mm. long; corolla 13 to 15 mm. long, silky pubescent. Legume glabrous, thick, 15 cm. long and over, about 4 cm. broad, the margins very prominent.

PANAMÁ: Near Cruces, Canal Zone, in woods (*Seemann* 407, type); Bismarck above Penonomé, province of Coclé, leaves only March 19, 1908 (*Williams* 589).

30. **Inga Purpusii** Pittier, Contr. U. S. Nat. Herb. **18**: 199. **1916.**

Branchlets angular, brownish hairy. Rachis of the leaves densely hairy, 10 to 13.5 cm. long, narrowly winged between the two terminal pairs of leaflets; stipules ovate or oblong, densely pubescent, 7 to 10 mm. long; glands obsolete, or very small and subsessile; leaflets 2 to 3-jugate, briefly petiolulate (the petiolules about 1 mm. long), ovate to oblong, acute or short-acuminate, more or less sparsely hairy all over, reticulate, 10 to 18 cm. long, 5 to 9 cm. broad, the costa and veins more or less pubescent and prominent on both faces. Floral spikes axillary or terminal, the peduncles ferruginous-hairy, 3 to 5 cm. long; bractlets lineal, hairy, 2 to 2.5 mm. long; calyx striate, 17 to 20 mm. long, minutely pubescent; corolla 29 to 32 mm. long, villous. Legume 30 cm. long, more or less, 2.7 cm. broad, glabrous, with thick, rounded margins.

MEXICO: Finca Yolanda, Chiapas, flowers and fruits September 1913 (*C. A. Purpus* 6811, type).

31. **Inga lindeniana** Benth. Hook. Lond. Journ. Bot. **4**: 608. **1845.**

A tree; branchlets angular, densely rufous-hirsute. Rachis winged, also rufous-hirsute, the wings attenuate at both ends; leaflets 3-jugate, ample, membranous, subsessile; leaflet blades ovate, acuminate, light green and softly hairy above, velvety beneath, the larger ones, terminal, 23 cm. long 11.5 cm. broad. Floral spikes pedunculate,, the heads oblong; flowers sessile; bracts lineal-lanceolate, caducous; calyx tubular, striate, silky puberulous, 10.6 mm. long; corolla silky villous, 23.3 mm. long. Legume 15 to 30 cm. long or over, 5 to 6.5 cm. broad. densely rufous-villous, thick, flat before maturity, screw-twisted later.

MEXICO: Teapa, State of Tabasco, México (*Linden* 726, type).

32. **Inga Goldmanii** Pittier, Contr. U. S. Nat. Herb. **18**: 198. **1916.**

A tree 6 to 10 m. high, with depressed, spreading crown; branchlets angular, the younger growth, the rachis of the leaves and the peduncles densely rufous hairy. Rachis of the leaves winged, 9 to 25 cm. long, the petiolar part 2 to 4 cm. long; stipules heart-shaped, obtuse; glands sessile or stipitate; leaflets 3 to 4-jugate, almost sessile, coriaceous; blades oblique, ovate to oblong, rounded at the base, obtuse or acute at the apex, sparsely villous, the venation impressed above and strongly prominent beneath, 7 to 20 cm. long, 5 to 11 cm. broad. Inflorescences axillary, long pedunculate; calyx 14 mm. long, densely fulvous-pubescent; corolla densely fulvous-hairy, 25 mm. long, the lobes

8 mm. deep, narrow and acute; stamen tube inclosed. Legume flat or twisted, sessile, long stipitate, rounded or subacute at the apex, 20 cm. long or more, 3.5 to 4.5 cm. broad, densely rufous-hispid, the margins rounded and deeply sulcate on the sutural line.

COSTA RICA: In forest at Banana River near Port Limón, leaves only May 1, 1903 (*Cook & Doyle* 429); Río Hondo; plains of Sta. Clara, in pastures; fruits May 1902, *Pittier* (Inst. Fís. Geogr. 16376).

PANAMÁ: Near Gatún, Canal Zone, fruits February 10, 1911 (*E. A. Goldman* 1866, type).

Series d–*Vulpinæ*

Branchlets, leaves and inflorescences hirtous, pilose or setose. Rachis of the leaves winged. Glands small, stipitate. Flower heads subelongate, short or long pedunculate. Bracts caducous.

Flowers sessile or pedicellate: corolla villous.
  Floral spikes briefly pedunculate; flowers sessile; medium-sized tree 34. *I. Tonduzii*
  Floral spikes long pedunculate; flowers pedicellate; shrub or small tree 35. *I. Cookii.*

33. **Inga Tonduzii** Donnell Smith, Bot. Gaz. **44**: 112. 1907.

A tree with rounded crown; branchlets densely ferruginous-setulous. Rachis of the leaves setulous, winged, 9 to 14 cm. long, the petiolar part naked, 1.5 to 2 cm. long, the wings 1.0 to 1.5 cm. broad, revoluted; stipules deltoid, acuminate, 10 to 12 mm. long, caducous; glands small, briefly stipitate; leaflets 2 to 3-jugate, sessile, coriaceous; blades elliptic or ovate-elliptic, rounded and subemarginate at the base, acuminate, hairy on both faces, 4 to 17 cm. long, 2 to 9 cm. broad. Inflorescences single or geminate in the axils, or 2 to 5-clustered at the end of the branchlets; peduncles densely hairy, about 2 cm. long, the flower-heads elongate, densely flowered; flowers sessile; bractlets lineal-lanceolate, hairy without, subpersistent; calyx 10 to 12 mm. long, sparsely hairy, striate; corolla yellowish white, 27 mm. long, deeply lobulate, villous; stamen tube inclosed; ovary glabrous. Legume flat and thin, sparsely hairy, 15 to 30 cm. long, 3.8 to 4.4 cm. broad, the margin rounded and deeply sulcate along the sutural line.

COSTA RICA: Las Vueltas de Tucurrique, in forest, flowers and fruits December 1898, *Tonduz* (Inst. Fís. Geogr. 12928, type).

34. Inga Cookii Pittier, Contr. U. S. Nat. Herb. **18**: 203. 1916. (Pl. XXXI.)

A shrub or small tree, all parts more or less covered with long, brown setulous hairs. Rachis of the leaves winged, 5 to 7.5 cm. long, the petiolar part 0.5 to 1 cm.; stipules ovate, 3 to 4 mm. long; glands small, long stipitate; leaflets 3-jugate, subsessile; the blades ovate to lanceolate, obtuse at the base, acuminate, hairy, ciliate on the margin, 3.5 to 13 cm. long, 2 to 5 cm. broad. Inflorescences axillary, single; peduncles slender, about 8 cm. long; flowers pedicellate; bractlets lanceolate, 2 to 4 mm. long, glabrous inside, subpersistent; pedicels about 2.5 mm. long; calyx tubular, 4 mm. long; corolla tubular, broadened toward the apex, about 11 mm. long, the lobes short and narrow; stamen tube inclosed. Legume not known.

GUATEMALA: Near the Finca Sepacuité, Alta Verapaz, in forest; flowers March 27, 1902 (*Cook & Griggs* 202, type, 226 & 505).

Series e—*Longifloræ*

Rachis of the leaves winged. Glands sessile or very briefly stipitate. Bractlets caducous. Flowers sessile, slender, very long, calyx striate, glabrous, except on the teeth; corolla silky villous. Legume flat or twisted, densely rufous hairy.

35. Inga mucuna Walpers & Duchass., Walp. Ann. **2**: 459. 1851–52. (Pl. XXVI.)

A middle sized tree with spreading crown, the branchlets angular, at first ferruginous-hairy. Rachis of the leaves winged, densely brown strigose-hairy, 11 to 22 cm. long, the petiolar part 2.5 to 3.5 cm., the wings 1.7 to 3 cm. broad; stipules heart-shaped, acute, 5 to 8 mm. long, persistent; glands very small, subsessile; leaflets 2 to 3-jugate, membranous, the petiolules hairy, 3 mm. long, the blades ovate-orbiculate to ovate, acute or abruptly acuminate, hairy-strigose above, tomentose-pubescent and reticulate beneath, 6 to 17.5 cm. long, 4 to 11 cm. broad, the terminal pair largest, the costa and veins densely hairy. Floral spikes axillary, single, the peduncles 5 to 8 cm. long, densely brown hairy; flowers sessile; bractlets elliptic, hairy, about 6 mm. long, caducous; calyx striate, 2 cm. long, glabrous except on the teeth tips; corolla slightly broader at the apex, white, villous, 4.5 cm. long, the lobes 7 mm. long or less; stamen tube slender, long exserted; stigma capitellate. Legume flat or screw twisted, sessile, up to 30 cm. long, 5 cm. broad, the margins rounded, the seeds numerous.

PANAMÁ: Panamá, 1850 (*Duchassaing* 81, type); banks of the Sambú River, southern Darien, flowers & fruits February 1, 1912 (*Pittier* 5525).

Series f—*Dysanthæ*

Habit and foliage of the *Euingæ*. Rachis of the leaves (in our species) wingless. Glands sessile. Floral spikes loose or erect; corolla and calyx densely covered with curled, felted hairs. Legume flat, rufous hairy.

36. **Inga standleyana** Pittier, Contr. U. S. Nat. Herb. **18**: 204. 1916.

A low tree with rounded crown, the young branchlets, peduncles, rachis of the leaves and flower heads densely rufous hairy. Rachis of the leaves wingless, terete, 10 to 15 cm. long, the petiolar part 2.5 to 4 cm; glands large, sessile, pertuse; leaflets 4-jugate, subsessile; the blades suboblique, ovate or obovate, rounded at the base, obtuse or acuminate, glabrous except on the costa above, softly villous and prominently veined beneath, ciliate on the margin, 5 to 13 cm. long, 4 to 8 cm. broad. Inflorescences axillary, geminate, elongate; peduncles 2.5 to 4 cm. long; bractlets ovate, very small and caducous; flowers sessile, the calyx and corolla densely tomentose; calyx 5 mm. long, the lobes 3 to 4 mm. deep; stamen tube inclosed, pink, colored as are the filaments; ovary hairy on the sutural lines; style about 5 cm. long. Legume flat and densely rufous hairy.

PANAMÁ: Vicinity of La Palma, southern Darien, in old clearings; flowers, January 26, 1912 (*Pittier* 5496, type).

Section 5. EUINGA

Flowers mostly broader than in *Pseudinga*, sessile in erect spikes, and usually falling off from the base of the spike as this becomes longer. Calyx tubular or sometimes campanulate, often sparsely hairy and longitudinally striate. Corolla silky pubescent or villous. Legume often briefly tomentose, thick, the margins broad, diversely sulcate, straight and impressed between the broad faces or twisted and more or less covering the latter. Indumentum mostly fulvous, rufous or ferruginous. Rachis of the leaves almost always winged. Glands sessile, substipitate or long stipitate, seldom obsolete. Leaflets 2 to 7-jugate. Inflorescences axillary, single or geminate. Flowers mostly over 1 cm. long, hardly ever exceding 2.5 cm.

Series a–*Tetragonæ*.

Legume straight or almost so, with a 4-angled cross-section, the faces broad and smooth, the margins, mostly concave, longitudinally sulcate. Inflorescences axillary, single or, seldom, geminate. Flowers long and slender; ovary 4-sulcate.

Rachis of the leaves winged between the two upper pairs of leaflets only; leaflets 2 or 3-jugate; calyx teeth short and densely hairy 37. *I. biolleyana.*

Rachis of the leaves winged between all the leaflets pairs; calyx teeth mostly long and sparsely hairy.

- Leaflets 5–6-jugate. Legume very short (5 cm. long) 38. *I. Calderoni*
- Leaflets 3–, mostly 4-jugate, seldom over 13 cm. long
  - Peduncles of the floral spikes 2 to 2.5 cm. long; bractlets unusually conspicuous, up to 2.2 cm. long; pubescence mostly fulvous and dense 39. *I. Rensoni*
  - Peduncles of the floral spikes 6 to 10 cm. long; bractlets not very conspicuous, up to 1.4 cm. long; pubescence brownish and never very dense 40. *I. Preussii*
- Leaflets 2 to 5, mostly 3-jugate, the terminal pair almost always over 13 cm. long
  - Legume 1.5 cm. long, more or less 4-angled; leaflets 4–5-jugate, 6–10 cm. long; a shrub; interfoliolar glands substipitate 41. *I. salvadorensis*
  - Legume seldom less than 9 cm. long
    - Glands long stipitate; leaflets sparsely hairy beneath: corolla about 32 mm. long 42. *I. jimeneziana*
    - Glands sessile or briefly stipitate; leaflets softly villous or pubescent beneath; corolla not over 24 mm. long 43. *I. Pittierii*

37. **Inga biolleyana** Pittier, Contr. U. S. Nat. Herb. **18**: 207. 1916.

A small tree. Rachis of the leaves winged only under the upper leaflet pair, or not winged at all, ferruginous-pubescent, 4 to 9 cm. long; stipules broadly ovate, acute, 7 to 9 mm. long, persistent; glands small, briefly stipitate, often obsolete; leaflets mostly 3-jugate, sometimes less, the petiolules 2 to 3 mm. long, the blades ovate-elliptic, acute, sparsely glabrescent above, paler, reticulate and sparsely hairy beneath, 4.5 to 15 cm. long, 2 to 6 cm. broad, the costa and veins pubescent on both faces and very prominent beneath. Floral spikes single in the upper axils, the peduncles ferruginous-hairy, 1 to 1.5 cm. long; bractlets lineal-lanceolate, 9 to 12 mm. long, persistent; calyx about 11 mm. long, the tube sparsely fulvous-pubescent, the teeth short, densely hairy; corolla tubular, broadening toward the apex, 28 to 31 mm. long, stamen tube long exserted, the filaments purple; ovary 4-sulcate. Legume not known.

COSTA RICA: Turrialba, at an altitude of 750 meters, in pastures; flowers November 1893, *Tonduz* (Ins. Fís. Geogr. 8391, type).

38. **Inga Calderoni** Standley, Journ. Wash. Acad. Sc. **13**: 352. 1923.

Young branchlets densely pilose with short fulvous hairs. Rachis of the leaves 5.5 to 9 cm. long, narrowly winged, densely short-pilose; leaflets 5-6-jugate, narrowly oblong-lanceolate, long-attenuate, obliquely obtuse or rounded at the base, 7 to 10.5 cm. long, 1.5 to 2.2 cm. broad, copiously fulvous-pilose above with subappressed hairs, more densely pilose with mostly spreading hairs beneath. Legume oval-quadrate, strongly compressed, 5 cm. long, 3.5 cm. broad, nearly 1 cm. thick, covered with a dense feltlike tomentum of stiff fulvous hairs.

EL SALVADOR: Comasagua, fruits December 1922 (Dr. S. Calderón No. 1392, type).

The description of this species is too incomplete to permit of its being put with certainly in its right place. The legume would suggest a member of the *Pseudinga-Vulpinae*, a series not represented heretofore in Central America, but the other characters indicate a close relation with the *Euingae-Tetragonae*.

39. **Inga Rensoni** Pittier, Contr. U. S. Nat. Herb. **18**: 209. 1916.

A medium-sized tree. Rachis of the leaves densely fulvous hairy, winged, 8 to 12 cm. long, subwinged below the basal leaflets; stipules ovate or oblong, obtuse, 6 to 12 mm. long, persistent; glands subsessile, irregular; leaflets mostly 4-jugate, sometimes less, the petiolules 2 to 3 mm. long, densely fulvous-hairy, the blades ovate or ovate-lanceolate, acute, pubescent above, reticulate and tomentose-pubescent beneath, 6 to 13 cm. long, 2.5 to 6 cm. broad, the costa and veins densely fulvous-hairy. Floral spikes single in the axils, the peduncles fulvous-hairy, 2 to 2.5 cm. long; bractlets very conspicuous, lineal-lanceolate or ovate, 1 to 2.2 cm. long, subpersistent; calyx irregular in length (14 to 22.5 mm.) striate, sparsely appressed pubescent; corolla silky villous, 21 to 22 mm. long, the lobes short and obtuse; stamen tube inclosed. Legume glabrous, substipitate, about 18 cm. long, the faces flat or concave, 3 to 3.5 cm. broad, coming together at the pointed apex, the margin concave, 1 to 2 cm. broad.

EL SALVADOR: Vicinity of San Salvador, in coffee-plantations (*C. Renson* No. 239, type).

40. Inga Preussii Harms, Repert. Sp. nov. **13**: 420. 1914. (Pl. XXVII.)

A tree about 15 m. high. Rachis of the leaves winged except on the petiolar part, brownish-villous, 5 to 13 cm. long; stipules ovate or ovate-lanceolate, tomentose-pubescent without, about 5 mm. long; glands small, subsessile; leaflets 3 to 4-jugate, the petiolules 2 mm. long or less, the blades ovate to ovate-elliptic or oblong, acute or acuminate, sparsely pilous above, reticulate and densely villosulous beneath, 5.5 to 12 cm. long, 2.5 to 7 cm. broad, the costa and veins pubescent on both faces. Floral spikes single or geminate in the axils, the peduncles 6 to 10 cm. long; bractlets lanceolate, acute, 7 to 14 mm. long; calyx villosulous or sparsely hairy, 10 to 12 mm. long; corolla silky villous, about 2 cm. long; stamen tube shortly exserted. Legume sessile, stipitate, glabrous, 21 cm. long, more or less, the faces 2.5 to 3.5 cm. broad, concave, meeting in a rounded apex, the margin concave, 3-sulcate, 1 to 1.5 cm. broad at the base and narrowing toward the apex.

EL SALVADOR: Hacienda Guadalupe near San Salvador, flowers February 1900 (*Preuss* 1386, type); above Izalco, Department of Sonsonate, at an altitude of 800 meters, fruits February 1907 (Pittier 1974).

41. **Inga salvadorensis** Britt. & Rose, North-Amer. Fl. **23**: 12. 1928.

A shrub, the twigs densely brownish-pubescent. Rachis of the leaves winged, densely pubescent, the petiolar part 1–2 cm. long; leaflets 4 to 5-jugate, lanceolate to oblong, acuminate, 6 to 10 cm. long, entirely pubescent, venation very prominent beneath. Floral spikes 4 cm. long. Legume 1.5 cm. long, somewhat flattened, more or less 4-angled, velvety pubescent.

EL SALVADOR: Near San Salvador, 1923 (Dr. S. Calderón 1828).

The main features of this new species would be its reduced size and, above all, its extraordinary fruits. The very incomplete description reproduced above shows that only imperfect specimens have been collected. The legitimacy of this type must be considered doubtful until better and more copious materials are at hand. Its description reminds that of *Inga Calderoni* Standley, cited above.

42. **Inga jimeneziana** Pittier, Contr. U. S. Nat. Herb. **18**: 208 1916.

A tree with rounded crown. Rachis of the leaves narrowly winged, sparsely ferruginous-hairy, 5 to 15 cm. long, the petiolar part terete or hardly marginate; stipules ovate-lanceolate, acute, 1 to 2 cm. long, pubescent, persistent; glands small, mostly long stipitate; leaflets 2 to 3-jugate, seldom 4-jugate, subsessile (i. e. the petiolules not over 1 mm. long), the blades broadly ovate to ovate-elliptic, acuminate, lustrous and sparsely hairy above, reticulate beneath, 7 to 21 cm. long, 3 to 11 cm. broad, the costa and veins fulvous-hairy on both faces. Floral spikes single or geminate in the upper axils, the peduncles fulvous-hairy, 1.5 to 4 cm. long; bractlets lanceolate to lineal, 1 to 1.5 cm. long, persistent; calyx striate, fulvous-pubescent, about 12 mm. long, the teeth narrow and subulate; corolla tubular, broadened at the apex, about 32 mm. long, the lobes short and broad; stamen tube included, the filaments deep purple. Legume sessile, glabrous, 11.5 to 30 cm. long, the faces 3 cm. broad, the margin 1.5 cm. broad, 2-sulcate.

COSTA RICA: Banks of Colorado River near Turrialba; flowers and fruits November 1893, *Tonduz* (Inst. Fís. Geogr. 8333, type); Aragón near Turrialba, flowers October 1894, *Pittier* (Inst. Fís. Geogr. 9041); Las Vueltas de Tucurrique, in pastures, flowers and fruits April 1892, *Tonduz* (Inst. Fís. Geogr. 13055).

43. **Inga Pittierii** Micheli, Bull. Herb. Boiss. **2**: 446, pl. 13. 1894.

A small tree. Rachis of the leaves rufous or fulvous pubescent, either terete, marginate or narrowly winged, 6 to 17 cm. long; stipules ovate, oblong or lanceolate, obtuse, 8 to 16 mm. long, subpersistent; glands small, sessile or substipitate; leaflets 3-jugate or seldom less, the petiolules 2 to 4 mm. long, the blades ovate to ovate-elliptic, acute or abruptly acuminate, sparsely scabrous-pubescent or glabrescent above, reticulate and softly pubescent beneath, 6 to 23 cm. long, 2.5 to 11 cm. broad, the costa and veins densely fulvous-pubescent on both sides. Floral spikes single in the upper axils, the peduncles 1 to 4 cm. long, densely fulvous-pubescent; bractlets ovate to lineal-lanceolate, pubescent, 5 to 12 mm. long, subpersistent; calyx 8 to 13 mm. long, pubescent, striate, the teeth subulate; corolla tubular, broadening toward the apex, sparsely appressed villous, 19.5 to 24 mm. long, the lobes narrow, densely villous; stamen tube included or slightly exserted, the filaments pink. Legume sessile, glabrous, 9 to 18 cm. long, the faces and margins about equally (1.5 to 2.5 cm.) broad, joining in a cuspidate apex.

COSTA RICA: Banks of Río Ceibo near Buenos Aires, Diquís basin, flowers and fruits February 1892, *Tonduz*, (Inst. Fís. Geogr. 4977, type); around Sto. Domingo de Osa, in forests, flowers and fruit March 1896, *Tonduz* (Inst. Fís Geogr. 10030); near Juan Viñas, in coffee plantations, fruits April 26, 1903 (*Cook & Doyle* 389).

PANAMÁ: Forests around San Félix, eastern Chiriquí, flowers December 30, 1911, (*Pittier* 5452); Bismarck above Penonomé province of Coclé, fruits March 5–19, 1908 (*Williams* 489).

Series b—*Sulcatæ*.

Fruits assuming more or less the appearance of a piece of rope, the margins entirely or partly covering the faces.

Rachis of the leaves wingless, or winged only between the two upper leaflet pairs.

Leaflets oblong-elliptic; main rachis quite wingless 44. *I. cocleensis.*

Leaflets mostly broadly ovate, sometimes oblong; main rachis often narrowly winged between the two upper pairs 45. *I. eriorhachis.*

Rachis of the leaves winged from the basal leaflets to the apex

Flowers relatively small and slender, the calyx not over 10 mm. long

Leaflets usually 3–4-jugate; floral spikes single, geminate or at the most ternate in the axils of the leaves

Bractlets obtuse, very small; glands very small, corolla 15 to 17 mm. long, the calyx 8 to 10 mm. with short teeth 46. *I. pauciflora.*

Bractlets acute or acuminate, rather large; glands large, concave

Corolla 10 to 12 mm. long, the calyx 5 to 7 mm. 47. *I. Endlichii.*

Corolla 12 to 13 mm. long, the calyx 7–8 mm. 48. I. *latibracteata.*

Leaflets usually 4 to 6-jugate; inflorescences mostly 2 to 6-clustered. and paniculate; glands large

Young branchlets, rachis of the leaves and floral spikes rusty-tomentellose or puberulous; calyx grayish-pubescent 49. *I. edulis.*

Young branchlets, rachis of the leaves and floral spikes densely rubiginous-pubescent; calyx and corolla also rubiginous-hairy 50. *I. oerstediana.*

Flowers relatively large and broad, the calyx not under 10 mm. long

Flowers more or less stipitate; bractlets suborbiculate
51. *I. spuria*

Flowers all sessile; bractlets ovate or lanceolate

Corolla not over 17 mm. long

Leaflets ovate or oblong to lanceolate, 2.5–9 cm. long, 1 to 3.5 cm. broad; interfoliolal glands small; bractlets ovate-lanceolate 6 to 8 mm. long 52. *I. xalapensis*

Leaflets oblong, lanceate-oblong or oblanceate-oblong, up to 17 cm. long and 6.5 cm. broad; interfoliolal glands large; bractlets lanceolate, acute, 8–12 mm. long
53. *I. Sciadondendron*

Corolla not less than 20 mm. long

Calyx not over 15 mm. long

Staminal tube almost equalling the corolla
54. *I. eriocarpa*

Staminal tube long-exceeding the corolla
55. *I. oophylla*

Calyx over 19 mm. long

Corolla 27.5 to 29.5 mm. long; leaflets 3 to 4-jugate, petiolulate 56. *I. rodrigueziana*

Corolla not over 23 mm. long

Leaflets 7-jugate; corolla longer than the calyx; pubescence rufous
57. *I. Donnell Smithii*

Leaftlets 6-jugate; corolla usually shorter than, or equal to, the calyx; pubescence grayish
58. *I. fissicalyx*

44. **Inga cocleensis** Pittier, Contr. U. S. Nat. Herb. **18**: 211. 1916.

A tree, the young branchlets, rachis of the leaves and floral peduncles rubiginous-pubescent. Rachis of the leaves wingless, 18.5 cm. long; glands large, transversally ovate; leaflets 6-jugate, coriaceous, the petiolules 3 to 5 mm. long, thick, densely pubescent, the blades elliptic-oblong, broadly rounded at the base, acuminate, strigose-pilosulous above, densely pubescent and reticulate beneath, 4 to 13 cm. long, 1.5 to 4.5 cm. broad, the costa and veins rubiginous-pubescent, both prominent on the lower face, the latter impressed on the upper face. Floral spikes single, axillary; peduncles 4 to 5 cm. long; calyx 6 to 7 mm. long, tubular, rubiginous-pubescent, corolla. . . . Legume slender, terete, minutely rubiginous-pubescent, twisted, 10 to 20 cm. long.

PANAMÁ: Bismarck above Penonomé, province of Coclé, at an altitude of 700 to 1000 meters, fruits March 1908 (Williams 405, type).

45. **Inga eriorhachis** Harms, Repert. Sp. nov. **13**: 525. 1915.

A middle-sized tree, the young branchlets, rachis of the leaves and floral peduncles densely ferruginous-pubescent. Rachis of the leaves wingless or narrowly winged between the two upper pairs of leaflets, 12 to 16 cm. long; stipules very caducous; glands obsolete; leaflets 4 to 5-jugate, coriaceous, the petiolules 1 to 2 mm. long, the blades ovate or oblong, obtuse or rounded at the base, obtuse or shortly acuminate at the apex, 8 to 17 cm. long, 5 to 11 cm. broad, more or less villosulous on both faces, sublustrous above, paler and reticulate beneath, the costa and veins densely ferruginous-pubescent. Floral spikes 2 to 5-clustered in the upper axils, the peduncles 4 to 6 cm. long, the flower heads spiciform, 4 to 6 cm. long; flowers sessile; bractlets obovate, 3 to 4 mm. long, very caducous; calyx tubular, ferruginous-villous, 6 to 8 mm. long; corolla 11.5 to 14.5 mm. long, ferruginous-villous. Legume not known.

COSTA RICA: Hacienda Belmira, near Santa María de Dota, at an altitude of 1450 meters; flowers January 1898, *Tonduz* (Inst. Fís. Geogr. 11636, type).

46. **Inga pauciflora** Walp. & Duchass., Bot. Syst. **2**: 460. 1848–50.

A bushy shrub, about 3 m. high; young branchlets, rachis of the leaves and floral peduncles ferruginous-hairy or pubescent. Rachis of the leaves 4.5 to 8.5 cm. long, winged except on the very short petiolar part; stipules ovate, obtuse, about 4 mm. long; glands very small, subsessile; leaflets 2 to 4, mostly 3-jugate, coriaceous, the petiolules about 1 mm. long, the blades ovate to ovate-elliptic or obovate, obtuse or acuminate, 2 to 13 cm. long, 1.5 cm. broad, appressed-pilosulous above, villous-tomentose beneath, the costa and veins impressed on the upper face, densely villous-tomentose and prominent on the lower face. Floral spikes single or geminate in the upper axils, the peduncles 1.5 to 2 cm. long; bractlets ovate, obtuse, very small and caducous; calyx ferruginous pubescent, 8 to 10 mm. long; corolla white, silky hairy, 15 to 17 mm. long; stamen tube included. Legume not known.

PANAMÁ: Pánamá (*Duchassaing*, type); Ancon Hill, Canal Zone, at an altitude of about 200 meters; flowers February 20, 1908 (*Williams* 32).

47. **Inga Endlichii** Harms, Repert. Sp. nov. **19**: 63. 1923.

A tree with the branchlets more or less angulous, shortly villous. Rachis of the leaves villosulous, rather broadly winged between the leaflets pairs, 6 to 12 cm. long, the petiolar part 2 to 3.5 cm., wingless; glands large, concave; leaflets 3-jugate, oblong, obovate or ovate, 6 to 15 cm. long, 3 to 8 cm. broad, the base rounded or slightly emarginate, the apex shortly acuminate, the upper face at first puberulous and later glabrescent, with the midrib hairy, the lower face villous or pilosulous, and reticulate. Floral spikes geminate or ternate in the axils, 3.5 cm. long; the peduncles short; flowers sessile; bractlets large, oval or oval-oblong, villous, 3 to 7 cm. long; calyx short, 5 to 7 mm. long, villosulous, more or less striate; corolla thickly silky-villous, 10 to 12 mm. long.

MEXICO: Vicinity of Jalapa, 1410 m., Veracruz, in gardens and hedges; flowers February 1907 (R. *Endlich* 1536, type, in Berlin bot. Museum).

48. **Inga latibracteata** Harms, Repert. Sp. nov. **19**: 64. 1923.

A tree, the branchlets more or less angulous, ferruginous-velvety. Rachis of the leaves 7 to 9 cm. long, rather broadly winged between the leaflet pairs; glands large, concave; leaflets 3 to 4-jugate, 6 to 13 cm. long and 3 to 6 cm. broad, oval-oblong-lanceolate, the base more or less oblique and rounded, the apex acute or acuminate, the upper face sparsely pilose, with the midrib villous, the lower face more densely villous and reticulate. Floral spikes 3 to 5 cm. long, densely velvety-villous; bractlets large, ovate to oval-lanceolate, acute or acuminate, densely villous, 9 to 13 mm. long; calyx densely villous, 7 to 8 mm. long; corolla densely hairy, 12 to 13 mm. long or more.

MEXICO: Hills near Jalapa, 1,300 meters, Veracruz, flowers April 1899 (*Pringle* 8159, type, in Berlin bot. Museum).

With the author, I feel inclined to consider these two types as mere variations of a single species. They are so very closely related indeed, that it is hard to understand how, in the *North American Flora,* the first happens to be placed within the relationship of *Inga leptoloba,* and not with the second in the group of *Inga xalapensis* or *I. spuria.* The latter species (*I latibracteata*) had been placed by myself, in 1916 under *I. edulis.*

49. Inga edulis Mart. Herb. Fl. bras. **113.** (Pls. XXVIII, XXIX, XXX.)

A tree 8 to 20 m. high, the indumentum of the branchlets, rachis of the leaves & floral peduncles, ferruginous. Rachis of the leaves tomentellose, usually winged, 6.4 to 14 cm. long; stipules oblong, obtuse, about 5 mm. long, very caducous; glands large, transversally oblong, sessile; leaflets 3 to 6-jugate, mostly 4-jugate, subcoriaceous, the petiolules tomentellous, about 2 mm. long, the blades ovate or obovate to elliptic, broadly rounded at the base, acute or acuminate, 4 to 19 cm. long, 2 to 10 cm. broad. more or less sparsely pilosulous or glabrescent and sublustrous above, paler and more or less minutely hairy beneath, the costa and veins ferruginous-tomentose, the latter slender and impressed on the upper face, the costa, veins and transverse venules prominent on the lower face. Floral spikes single or 2 to 6 clustered in the upper axils, the peduncles 2 to 3 cm. long, densely tomentellous; bractlets ovate to lanceolate, shorter than the calyx, deciduous; flowers sessile: calyx grayish appressed-pubescent, 6 to 7 mm. long; corolla subcampanulate, silky villous, 15 to 16 mm. long; stamen tube briefly exserted, Legume funiculiform, straight or helicoidally curved, ferruginous tomentose, 30 to 75 cm. long and over, 2 cm. in diameter and over, the sulcate margins almost entirely covering the faces; the peduncles thick, 4 to 5 cm. long.

MEXICO: Near Orizaba, Veracruz (*Mueller* 708 and 2208); Jalapa, Veracruz (*Schiede*); near Misantla, Veracruz, flowers March 1892 (*Schiede*).

GUATEMALA: Setzimaj, Alta Verapaz, flowers March 19, 1902 (*Cook & Griggs* 50; photo. 3641); around Sepacuité, Alta Verapaz, flowers March 27 and April 15, 1902, and May 1904 (*Cook* 124, 228, 620; photo. 3751) (habit of tree) and 3750 (leaf and inflorescence); Cobán, Alta Verapaz, flowers May 1907 (*von Tuerckheim* II, 1774); near Esperanza, western Guatemala, flowers January 19, 1905 (*Maxon & Hay* 3355).

COSTA RICA: San José, in coffee plantations, flowers May 1888 *Pittier* (Inst. Fís. Geogr. 233 bis); Térraba, in forest, flowers February 1891, *Tonduz* (Inst. Fís. Geogr. 3825); Guácimo, llanos de Santa Clara, young fruits (*Tonduz* 148, United Fruit Co's. Herbarium, in U. S. Nat. Herbarium); Las Cóncavas, near Cartago, in coffee plantations, flowers April 7, 1903 (*Cook and Doyle* 19 and 20); Las Vueltas de Tucurrique, Reventazón Valley; flowers and young fruits November 1898, *Tonduz* (Inst. Fís Geogr. 12745); Suerre, llanos de Santa Clara, fruits April

1896 (*Donnell* Smith 6991); forests of Xirores, Talamanca, flowers February 1895, *Tonduz* (Inst. Fís. Geogr. 9357); Boruca, Diquís basin, December 1891, *Tonduz* (Inst. Fís. Geogr. 4710).

PANAMÁ: Between Gorgona & Mamei, Canal Zone; flowers February 9, 1911 (*Pittier* 2696).

50. **Inga oerstediana** Benth. in Seemann, Bot. Voy. Herald: **117.** 1852–57.

A middle-sized, spreading tree; branchlets, rachis of the leaves, petiolules, costa and veins of the leaves, and floral peduncles densely rubiginous-pubescent. Rachis of the leaves winged, 10 to 15 cm. long; glands obsolete or, when present, large and transversally ovate; leaflets 3 to 5-jugate, subcoriaceous, the petiolules 2 to 4 mm. long, the blades oblique or suboblique, ovate to elliptic, obtuse or acute at the apex, 4 to 15 cm .long, 2.5 to 7.5 cm. broad, softly pubescent of glabrescent above, more or less densely tomentose and reticulate beneath, the veins impressed on the upper face, the costa and veins prominent on the lower face. Floral spikes single or 2 to 5-clustered in the upper axils; flowers sessile; bractlets very small and caducous; calyx 4 to 8 mm. long, rubiginous-pubescent; corolla tubular, broadening toward the apex, 14 to 16 mm. long, rubiginous-villous; stamen tube equal to the corolla. Legume funiculiform, long, more or less twisted, the margins, deeply sulcate, almost entirely covering the faces.

MEXICO: Sine loc. (*Mueller* 708, coll. 1853).

COSTA RICA: Candelaria Mountains (*Oersted*); El Copey, Dota Mountains, in forests, flowers February 1898, *Tonduz* (Inst. Fís. Geogr. 11683); banks of Río Ciruelas above Barba, flowers March 15, 1890, *Tonduz* (Inst. Fís. Geogr. 2236); near San José, flowers May 2, 1890, *Pittier* (Inst. Fís. Geogr. 2372).

PANAMÁ: El Boquete de Chiriquí (*Seemann*, type); in pastures near El Boquete, Chiriquí, at an altitude of about 1100 m., flowers March 16, 1911 (*Pittier* 3130).

51. **Inga spuria** Humb. & Bonpl., Willd. Sp. Pl. **4**: 1011. 1806.

A small tree; branchlets grayish or brownish-pubescent. Rachis of the leaves grayish or brownish pubescent, winged, 10 to 17 cm. long; stipules deciduous; glands orbiculate, sessile: leaflets 5 to 7-jugate, subcoriaceous, the petiolules not over 1 mm. long, the blades ovate to elliptic-oblong, acute or subacuminate, or sometimes obtuse, 4.5 to 17 cm. long, 2 to 8 cm. broad, hirtellous or glabrescent and sublustrous above, reticulate and glabrescent to softly tomentose beneath, the costa and veins pubescent, strongly prominent on the lower face. Floral spikes axillary and mostly geminate, or terminal and 2 to 4-clustered in the upper axils, the peduncles hairy, 3 to 5.5 cm. long; flowers sessile; bractlets ovate, 5 to 6 mm. long, caducous; calyx more or less stipitate, broad, substriate, pubescent, 10 to 11.5 mm. long; corolla broad, silky hairy, greenish or yellowish white, 15 to 19 mm. long, the lobes reflected; stamen tube almost equal to the corolla. Legume more or less funiculiform, stipitate, cuspidate, softly brownish-pubescent, 5 to 30 cm. long, 1 to 1.5 in diameter, the sulcate margins more or less expanded over the faces.

Type from Venezuela, without precise locality (*Humb. & Bonpl.*)

Mexico: Santa Lucrecia, Isthmus of Tehuantepec, flowers March 29, 1895 (*C. L. Smith* 991); San Luis, Guerrero, flowers March 1899 (*Langlassé* 932); between Puerto Angel and Pochutla, Oaxaca, flowers March 15, 1895 (*E. W. Nelson* 2461); Catemaco, Veracruz, flowers April 26, 1894 (*Nelson* 425); Gómez Farias, Tamaulipas, flowers April 1907 (*Palmer* 290); La Palma, Jalisco, flowers June 9, 1892 (*M. E. Jones* 183); Acapulco, Guerrero, flowers October 1895 (*Palmer* 250): vicinity of Tampico, Tamaulipas, flowers June 1910 (*Palmer* 568); vicinity of Panuco, Veracruz, flowers April 1910 (*Palmer* 362): valley of Los Reyes, Michoacán, flowers February 7, 1903 (*Nelson* 6844); Tamasopo Cañón, San Luis de Potosí, flowers June 9, 1915 (*Pringle* 5048); near Cuernavaca, Morelos, flowers May 27–30, 1899 (*Rose* and *Hough* 4361).

Guatemala: Boca del Cahabón, Izabal, flowers April 1889 (*Donnell Smith* 1673); San Juan Mixtán, Escuintla, alt. 107 m. flowers April 1890 (*Donnell Smith* 2317); Laguna de Ayarza, Jalapa, fruits September 1892 *Heyde & Luz* (Donnell Smith 3727); Cubilquitz, Alta Verapaz, flowers May 1901, *von Tuerckheim* (Donnell Smith 7854); Gualán, Izabal, flowers and fruits January 14, 1905 (*C. Deam* 380); road from Secanquím to Cahabón, leaves only March 30, 1902 (*Cook & Griggs* 337); Patulul, Sololá, flowers February 14, 1906 (*Kellerman* 5883).

British Honduras: Near Manatee Lagoon, in forest, flowers, March 9, 1906 (*Peck* 374).

El Salvador: Near Izalco, Sonsonate, flowers February 14, 1907 (*Pittier* 1892).

Nicaragua: Sine data (*Wright*).

Costa Rica: Banks of Río Virilla near La Uruca, flowers July 1888, *Pittier* (Inst. Fís. Geogr. 358); Los Desamparados, flowers April 1887, *Biolley* (Inst. Fís. Geogr. 1018); Salinas Bay, Guanacaste, in forest, flowers and fruits July 7, 1890, *Pittier* (Inst. Fís Geogr. 2726); Echeverría, Alajuela, flowers May 25, 1890, *Pittier & Tonduz* (Inst. Fís. Geogr. 2515); banks of the Ceibo River near Buenos Aires, Diquís Valley, flowers January 1892, *Tonduz* (Inst. Fís. Geogr. 3837); forests of Buenos Aires, Diquís valley, flowers January 1892, *Tonduz* (Inst. Fís. Geogr. 4988); San Francisco de Guadalupe, in hedges, flowers and fruits June 1893, *Tonduz* (Inst. Fís. Geogr. 8049); vicinity of Nicoya, flowers March 1900, *Tonduz* (Inst. Fís. Geogr. 13855); Boruca, Diquís Valley, in forest, flowers February 1891, *Tonduz* (Inst. Fís. Geogr. 3837); El Coyolar, near San Mateo, flowers (*Wercklé*).

PANAMÁ: Gatún railroad station, Canal Zone, flowers October 25, 1859 (*Hayes* 78); Panamá (*Seemann* 520); vicinity of Penonomé, province of Coclé, flowers February and March 1908 (*Williams* 137 and 334; Las Sabanas near Panamá City, flowers January 25, 1911, (*Pittier* 2538); along the Trinidad River, Canal Zone, flower July 20, 1911 (*Pittier* 3973).

52. **Inga xalapensis** Benth., Hook. Lond. Journ. Bot. **4**: 616. 1845.

A small tree, the younger growth more or less ferruginous-pubescent. Rachis of the leaves narrowly winged, at first ferruginous-pubescent and then glabrescent, 5 to 12 cm. long or more; glands small, concave, prominent; leaflets usually 5-jugate, sometimes less, or more, coriaceous, subsessile, the blades ovate or oblong to lanceolate, obtuse or acute, 2.5 to 9 cm. long, 1 to 3.5 cm. broad, sparsely pubescent or glabrescent and sublustrous above, reticulate and more or less densely ferruginous-pubescent to glabrescent beneath, the petiolules, costa and veins densely pubescent, the veins slender and impressed on the upper face, the costa and veins very prominent beneath. Floral spikes usually geminate, more or less densely paniculate at the end of the branchlets, the peduncles 2 to 4.5 cm. long, densely ferruginous-hairy; flowers sessile; bractlets ovate-lanceolate, 6 to 8 mm. long; calyx broad, the more so toward the apex, densely ferruginous-pubescent, 10 to 11.5 mm. long; corolla silky villous, 14.5 to 17 mm. long; stamen tube included, much shorter than the corolla. Legume 10 to 15 cm. long, more or less flattened or subterete, 1 to 1.5 cm. broad, more or less stipitate, cuspidate, densely velvety ferruginous, the faces narrow between the broad, obscurely sulcate margin.

MEXICO: Jalapa, Veracruz (*Linden* 671 type); Wartenberg near Tantoyuca, Veracruz, 1858 (*Ervendberg* 10); Córdoba Valley, Veracruz, flowers March 12, 1866 (*Bourgeau* 2040); Huejutla, Hidalgo, flowers April 1888 (*Seler* 894); between Salpa and Mascota, Jalisco, flowers March 13, 1897 (*E. W. Nelson* 4042); Orizaba, Veracruz (*Botteri*); Acaponeta, Tepic, flowers February 1895 (*F. H. Lamb* 536); San Pedro near Guadalajara, Jalisco, flowers February 25, 1907 (*Safford* 1414); Villa Unión, Sinaloa, flowers April 2, 1910 (*Rose, Standley & Russell* 13968).

GUATEMALA: Laguna de Amatitlán, flowers January 20, 1906 (*Kellerman* 6374):

COSTA RICA: Banks of Tirribí, near San José, fruits June 1891, *Pittier* (Inst. Fís. Geogr. 4258); La Verbena near San José, in woods, flowers, December 1894, *Tonduz* (Inst. Fís. Geogr. 9078).

53. **Inga Sciadodendron** Harms ,Repert. Sp. nov. **19**: 62. 1923.

A tree, the branchlets rather thin, thickly villous. Rachis of the leaves villous, more or less broadly winged between the leaflet pairs, 15 to 20 cm. long, the petiolar part wingless, 3 to 6 cm. long; glands large, concave; leaflets 4-jugate, oblong, oblong-lanceolate or oblong-oblanceolate, acuminate, the larger ones up to 17 cm. long or more, 6.5 cm. broad, almost glabrous above, more or less pilose beneath. Floral spikes geminate or solitary in the axils, the peduncles rather thin, villosulous, 6–10 cm. long or more; flowers sessile; bractlets lanceolate, acute, pilose, 8–12 mm. long; calyx rather narrow, appressed-pilose, 10–11 mm. long, corolla silky villous, 15 mm. long or more.

MEXICO: Mirador, Veracruz, flowers April 1921 and 1922 (*J. A Purpus* 279, type in Berlin bot. Museum).

Inga Sciadodendron Harms, is a member of the complex of forms grouped around *Inga xalapensis,* or more widely speaking, around *Inga spuria.* In presence of the extreme variability which characterizes the whole group, it is difficult to fix a definite limit to these so-called species, or to emit a judgment as to the value of any of them. Rather than to multiply them *ad infinitum* it may be preferable to consider *I. spuria* as the type species and to divide it into a few varieties, each one with a broad scope of characters.

54. **Inga eriocarpa** Benth., Hook, Lond. Journ. Bot. **4**: 615. 1845.

A small tree, the younger growth, rachis of the leaves and inflorescences densely fuliginous or brown hairy. Rachis of the leaves broadly winged, 10 to 12.5 cm. long; stipules ovate-lanceolate, 5 to 10 mm. long, deciduous; glands orbiculate, concave, sessile; leaflets 5, seldom 4 or 6-jugate, coriaceous, the petiolules 1 mm. long or less, the blades suboblique, ovate, subacute, 1.5 to 8.5 cm. long, 0.7 to

3.5 cm. broad, glabrescent or sparsely appressed hairy above, softly hairy and subreticulate beneath, the costa and veins densely fulvous hairy, strongly prominent on the lower face. Floral spikes paniculate at the end of the branchlets, sometimes sessile, but the peduncles mostly 1.5 to 2.5 cm. long; flowers sessile; bractlets ovate, fulvous hairy, about 8 mm. long, caducous; calyx turbinate, thickly fulvous hairy, 13 to 14 mm. long; corolla tubular-funnelform, silky-villous, 20 to 22 mm. long; stamen tube almost equal to the corolla. Legume subterete, sulcate, densely tomentose.

MEXICO: Between San Blas and Guadalajara, Tepic or Jalisco (*Coulter*); Cuernavaca, Morelos (*Bilimek* 136); Orizaba, Veracruz, flowers March 15, 1867 (*Bilimek* 127); Monte de Santa Inés, Michoacán, flowers March 17, 1898 (*Langlassé* 34).

55. **Inga oophylla** Riley. Kew Bull. **1923**: 401. 1923.

A small tree?, the branchlets ferruginous-tomentose, covered with prominent lenticels. Rachis of the leaves narrowly winged (the wings 7–9 mm. broad), ferruginous-tomentose, 16 cm. long; glands whitish; leaflets 4 or 5-jugate, ovate or oval-lanceolate, obliquely subcordate at the base, obtuse or subacute and long-mucronate at the apex, 5.5 to 12.5 cm. long, 3 to 5 cm. broad, smooth and lustrous above, opaque below and sparsely villous all over. Floral spikes loose, 6 or 7 cm. long, few flowered; flowers sessile; bractlets ovate or oval-lanceolate, obtuse, ferruginous-tomentose, 5 to 7 mm. long; calyx tubulous-campanulate, 18 mm. long; corolla 25 mm. long, densely silky without, glabrous within; stamen tube long-exserted; ovarium sessile, quadrangular, glabrous. Legume not known.

MEXICO: San Ignacio, at El Bosque, 110 m., Sinaloa (*González* 250 in Kew Herb., type)

The note appended after *I. Sciadodendron* also applies here, as well as to *I. eriocarpa* and other allied forms. According to its author, *Inga oophylla* differs from *I. eriocarpa* in its ovate or oval-lanceolate leaflets, long, mucronate at the apex, and in its more sparse indument; from *I. xalapensis* it is distinguished by the shape of the leaflets, the lighter indumentation, the smaller bracts, the inflorescences much looser and the fewer flowers.

56. **Inga Rodrigueziana,** Pittier, Contr. U. S. Nat. Herb. **18**: 209. 1916.

A tree. Rachis of the leaves winged, densely ferruginous-pubescent, 13 to 19 cm. long, the petiolar part terete or submarginate; stipules ovate, obtuse, pubescent, about 7 mm. long, deciduous;

glands subsessile, flattened at the apex; leaflets usually 3, often 4-jugate, large, coriaceous, the petiolules 2 to 5 mm. long, the blades elliptic-ovate or lanceate, broadly rounded at the base, acute or acuminate, sparsely villous above, reticulate and villous beneath, 10 to 21 cm. long, 5 to 10 cm. broad, the costa and veins densely ferruginous-pubescent, prominent on the lower face. Floral spikes single in the axils, the peduncles thick, hairy, 5 to 7 cm. long; bractlets lineal-lanceolate, pubescent, 10 to 18 mm. long, subpersistent; calyx densely silky villous, 27.5 to 28.5 mm. long; stamen tube about equal to the corolla; stigma subpeltate. Legume funiculiform, about 15 cm. long and 1.5 cm. in diameter, densely rufous-pubescent, the sulcate margins broad, inclosing the narrow, about 7 mm. broad, faces of the valves.

MEXICO: Tapachula, Chiapas; flowers, Nov. 15, 1918 (*Wilson Popenoe*).

GUATEMALA: Las Viñas, Department Santa Rosa, flowers, September 1893, *Heyde and Luz* (Donnell Smith 6095, type); Cubilquitz, Alta Verapaz, flowers, March 1901, *von Tuerckheim* (Donnell Smith 7855); El Rancho, Department Jalapa, flowers, January 12, 1908 (*Kellerman* 7670).

57. **Inga Donnell Smithii** Pittier, Contr. U. S. Nat. Herb. **18**: 211. 1916.

A tree, the younger growth, rachis of the leaves, peduncles, etc., densely rufous-hairy. Rachis of the leaves thick, winged, 11 to 18 cm. long; stipules ovate, rufous-hairy, about 4 mm. long, caducous; glands small, subsessile, suborbiculate; leaflets 7-jugate, coriaceous, the petiolules dark, very short, the blades oblique, oblong, acuminate, 4 to 14 cm. long, 1 to 3 cm. broad, sparsely appressed-hairy on both faces, dark green above, paler and reticulate beneath, the costa prominent and densely rufous-hairy on the lower face. Floral spikes single, axillary, few-flowered; flowers large, sessile; bractlets ovate, acute, 6 to 10 mm. long, early deciduous; calyx thick, slightly broadening toward the apex, densely rufous-hairy, 19 to 21 mm. long; corolla densely rufous-hairy, about 22 mm. long; the lobes ovate, acute, reflected; stamen tube included, the stamens about 7 cm. from the base; ovary villous at the base. Legume not known.

GUATEMALA: El Guarda Viejo, near Guatemala City; flowers February 1890 (*Donnell Smith* 2316, type).

58. **Inga fissicalyx** Pittier, Contr. U. S. Nat. Herb. **18**: 213. 1916.

A tree, the younger growth, rachis of the leaves and floral peduncles more or less densely covered with a brown, hirtellous pubescence. Rachis of the leaves narrowly winged, 11 to 14 cm. long; stipules ovate, subacute, 10 to 12 mm. long, 7 mm. broad, caducous; glands small, sessile, orbiculate or transversally ovate; leaflets 5, usually 6-jugate, coriaceous, the petiolules densely brown hairy, 2 to 3 mm. long, the blades lanceolate or oblanceolate, narrow and rounded at the base, acute, 2.5 to 11 cm. long, 1.5 to 3.5 cm. broad, sparsely appressed hairy above, softly hairy and reticulate beneath, the costa and veins densely brownish pubescent, prominent on the lower face. Floral spikes axillary, geminate, the peduncles 5 to 7 cm. long; flowers sessile; bractlets lanceolate, subacute, pubescent, about 10 mm. long, caducous; calyx narrow at the base and broader at the apex, 20 to 28 mm. long, densely fuliginous-pubescent, the teeth very long, narrow and pointed; corolla gradually broadening to the apex, softly villous, 18 to 23 mm. long, the lobes short and broad, reflected; stamen tube equal to the corolla. Legume not known.

MEXICO: Vicinity of Zacualpán, Veracruz, flowers May 1906 and 1909 (*Purpus* 1917 and 3684, type); banks of the Curahueso Creek near San Juan Bautista, Tabasco, flowers November 2, 1887 (*Rovirosa* 27).

GUATEMALA: Eastern Guatemala (*Brigham* in Gray Herbarium).

DISTRIBUTION OF THE MIDDLE AMERICAN SPECIES

Up to the present date (June 1929), about 240 species of *Inga*, or forms described as such, have been listed. Of these, 58, or about one fourth of the total number, have been reported from Middle America. Since this territory also corresponds to the northernmost part of the area occupied by the genus, it follows, that the dispersion center should be looked for in South America. The presence in the West Indies of three species (*I. dominicensis, martinicensis* and *punctata*) of the *Gymnopodae*, besides of *I. laurina* (Sect. *Bourgonia*) and *I. vera* and *ingoides* (*Euinga* ser. *Sulcatæ*) is perhaps an indication of the existence of the genus before the geological dislocation which brought about the separation of the islands from continental South America. It would also point to the antiquity of the three sections in reference.

In the following table, we have tried to give a general idea of the horizontal and vertical distribution of the Middle American species of *Inga*. As only two species (*I. laurina* and *punctata*) extends to the West Indies, and none of them reaches the Andine belt, we have omitted the corresponding columns.

Species	Horizontal				Distribution		Vertical	
					Watersheds		Altitudinal Range Belts	
	Middle & South America	South Central America	North Central America	Mexico	Atlantic	Pacific	Basal 0-1000 m.	Middle 1000-2600 m.
Sect. 1-LEPTINGA								
1 Inga portobellensis	......	—	......	......	—	—	0-100 m.	
2 —— gracilipes	......	—	......	......	—	......	0-100 m.	
3 —— saffordiana	......	—	......	......	......	—	500 m.	
4 —— Williamsii	......	—	......	......	—	......	—	
5 —— roussoviana	......	—	—	......	......	—	0-100 m.	
Sect. 2- DIADEMA								
6 Inga membranacea	......	—	......	......	......	—	—	
7 —— Peckii	......	......	—	......	—	......	0-100 m.	
8 —— Jinicuil	......	......	......	—	—	......	—	to 1400 m.
9 —— Paterno	......	—	—	—	......	—	—	to 2000 m.
10 —— radians	......	......	—	—	......	—	—	to 1650 m.
Sect. 3 - BOURGONIA								
11 Inga marginata	—	—	......	......	—	—	50-800 m.	
12 —— laurina	—	—	—	—	......	—	—	to 1470 m.
Sect. 4 --PSEUDINGA Series 2—*Gymnopodae*								
13 Inga brevipedicellata	......	......	......	—	—	......	to 1000 m.	
14 —— leptoloba	......	—	—	—	—	—	—	to 1500 m.
15 —— punctata	—	......	—	—	—	—		
16 —— pinetorum	......	......	—	......	—	......	from 0 to	1500 m.
17 —— ruiziana	—	—	......	......	—	—	0-300 m.	
18 —— Recordii	......	......	—	......	—	......	0-100 m.	
19 —— aestuarium	......	—	......	......	......	—	0-200 m.	
20 —— multijuga	......	—	—	......	—	......	0-1000 m.	
Series 3- *Pilosiusculae*								
21 Inga Hayesii	......	—	......	......	......	—	0-100 m.	
22 —— Turckheimii	......	......	—	—		......	......	to 1450
23 —— monticola	......	—	......	......	......	—	—	
24 —— cobanensis	......	......	—	......	—	......	......	1450 m.
25 —— mollifoliola	......	—	......	......	......	—	......	to 1300 m.
26 —— Pringlei	......	......	......	......	—	......	......	1330 m.
27 —— micheliana	......	......	—	......	......	—	......	1200 m.
Series 5—*Longiflorae*								
28 Inga Mucuna	......	—	......	......	......	—	0-100 m.	

NOTE: The straight line indicates the presence of the species in that part of America; the dotted line its absence.

Species	Horizontal			Distribution			Vertical	
					Watersheds		Altitudinal Range Belts	
	Middle & South America	South Central America	North Central America	Mexico	Atlantic	Pacific	Basal 0-1000 m.	Middle 1000-2600 m.
Series 6—*Calocephalae*								
29 Inga spectabilis	......	—	......	......	—	—	0-800 m.	
30 —— panamensis	......	—	......	......	—	—	—	
31 —— Purpusii	......	......	—	......	......	—	—	
32 —— lindeniana	......	......	—	......	—	......	—	
33 —— Goldmanii	......	—	......	......	—	......	0-800 m.	
Series 7—*Vulpinae*								
34 Inga Tonduzii	......	—	......	......	—	......	0-600 m.	
35 —— Cookii	......	......	—	......	—	......	0-800 m.	
Series 8—*Dysanthae*								
36 Inga standleyana	......	—	......	......	......	—	0-50 m.	
Sect. 5—EUINGA Series 1—*Tetragonales*								
37 Inga biolleyana	......	—	......	......	—	......	750 m.	
38 —— Calderoni	......	......	—	......	......	—	—	
39 —— Rensoni	......	......	—	......	......	—	—	
40 —— Preussii	......	......	—	......	......	—	400-800 m.	
41 —— salvadorensis	......	......	—	......	......	—	400 m.	
42 —— jimeneziana	......	—	......	......	—	......	600 m.	
43 —— Pittieri	......	—	......	......	—	—	0-1000 m.	
Series 2—*Sulcatae*								
44 Inga cocleensis	......	—	......	......	......	—	—	
45 —— eriorhachis	......	—	......	......	......	—	......	1450 m.
46 —— pauciflora	......	—	......	......	......	—	200 m.	
47 —— Endlichii	......	......	......	—	—	......	......	1410 m.
48 —— latibracteata	......	......	......	—	—	......	......	1300 m.
49 —— edulis	—	—	—	—	—	—	—	to 1100 m.
50 —— oerstediana	......	—	......	—	......	—	—	to 1200 m.
51 —— spuria	—	—	—	—	—	—	from 0	to 1100 m.
52 —— xalapensis	......	—	—	—	—	—	—	to 1200 m.
53 —— Sciadodendron	......	......	......	—	—	......	—	
54 —— eriocarpa	......	......	......	—	—	—	—	to 1000 m.
55 —— oophylla	......	......	......	—	......	—	110 m.	
56 —— rodrigueziana	......	......	—	......	—	—	—	to 1100 m.
57 —— Donnell Smithii	......	......	—	......	—	......	......	1200 m.
58 —— fissicalyx	......	......	—	—	—	......	—	......

From the table, the following main conclusions can be deducted:

Horizontal Distribution.

Six of the Middle American species, all of them old and well defined types, extend to South America. Of them two (*I. punctata* and *I. laurina*), are also common to the West Indies. Two more species (*I. marginata* and *I. ruiziana*) only are found at the extreme southern end of our territory, and *I. punctata* does not seem to go beyond the isthmus of Tehuantepec. The three remaining species (*I. laurina, edulis, spuria*) are widely scattered all over the continental area of the genus.

Of the twelve remaining Mexican species, three (*I. Paterno, leptoloba* and *xalapensis*), all well characterized types, extend over the whole area of Middle America, one *(I. fissicalyx)* reaches Northern Central America, and the remaining seven are local forms which, with the exception of *Inga Jinicuil*, are possibly only varieties of other listed species.

Forty-one species belong exclusively to Central America with but two (*I. roussoviana, multijuga*) common to both the northern and the southern sections. Of the remaining thirty nine, fifteen are localized in the North, and twenty-nine in the South, it being understood that the first section includes, besides the part of Mexican political territory south of Tehuantepec, British Honduras, Guatemala, Salvador, and Honduras, and the last one Nicaragua, Costa Rica and Panamá.

The third part of the species thus localized belong to *Euinga*. Several of them, when better known, may posibly be reduced to the condition of simple varieties of well established types.

The large number of forms reported from Middle America as compared with Mexico points to an increased endemism, and the comparison between North and South Central America shows that this becomes stronger as we progress toward our southernmost limit.

As we have seen, 58 out of the 240 species or forms of Inga known up to date occur in Middle America. In every sectional or serial division of the genus they constitude a minority, except in the case of series *Tetragonæ* of *Euinga*, in which seven out of a total of fourteen species have been found north of the isthmus of Darien only. The series *Sulcatæ* has 15 out of its 31 species represented in Middle America. It would seem likely, therefore, that, though on the whole *Inga* is an essentially South American genus, the section *Euinga* has found in Middle America conditions very favorable to the development of local types. It may even be assumed that the series *Tetragonæ* can claim Central America as its cradle. Of course, such hypothesis may be deeply modified in the course of further investigations.

With regard to the distribution according to watersheds of the Inga species listed for Middle America, we find that fourteen of them are found both on the Pacific and the Atlantic slopes, and the remaining forty-four are equally divided between both.

VERTICAL RANGE

Many species or forms are known from one station only and so we remain in the dark with reference to their altitudinal range. Of the others, about twenty five are restricted to the lower belt, and twenty one reach more or less high into the middle one. *Inga Paterno* has, so far as known, the record of altitude in Middle America. while *I. punctata* has the widest altitudinal distribution. Less than half the *Euinga-Sulcatæ* and all the *Pilosiusculæ* but one seem to prefer a temperate climate, while the rest are at home in the warmer belt or extend indifferently over both the lower and the inferior part of the Middle belt.

HABITAT, ASSOCIATIONS, HABIT

Several among the Middle-American species of Inga are known only under cultivation. and very little information has been collected as to their preferred habitat. As a general rule, they seem to thrive in rich, humid soil and moderately sheltered exposures. Some species, as *Inga spuria*, occur with frequence along large or small rivers, others (*I. punctata, laurina*, etc.) in light second growth groves, and others again (*I. oerstediana*) in clear spots of mountain forests. They do not as a rule form close associations, though in some cases considerable spots of an exclusive formation of *Inga spuria* or its affinities, have been observed around bogs or swampy places.

As to habit, several species are middle-sized trees, reaching sometimes (*I. punctata*) 15 to 18 meters in height, with a diameter of no less than 50 centimeters. Others. among which several forms or species of the group of *Inga spuria*, are mere bushy shrubs. When growing in close association with other forest trees, the shape of the crown is determined by the surroundings, but, in the open, a few species, like *I. laurina* and *I. punctata*, assume an elongated, broomlike shape, all the limbs forming an acute angle with the main axis. Other species, including all those of section *Diadema*, belong to the umbrella-shape type, with a short trunk and a single tier of horizontal or drooping branches. Lastly, a goodly number of species have a rather long, straight trunk, with several tiers of horizontal limbs.

CULTIVATED SPECIES AND THEIR USES

Three of the Middle-American species of Inga are known only under cultivation or semi-cultivation, either in coffee or cacao plantations or as shade and fruit trees around houses. They are *Inga Jinicuil, I. Paterno* and *Inga radians*. The fact that two of them have old nahuatl names, *xinicuil* and *quautlxinicuil*, points to an economic importance of very ancient date; they can be associated with ***Calospermum mammosum, Achras Sapota*** and ***Theobroma Cacao*** as the oldest fruit trees of the Middle-American aborigenes. It is interesting to note that they all belong to one single section of the genus and that they are closely allied.

Among the other species, the following are known both wild and used as shade trees in semi-cultivated condition.

Inga laurina
Inga brevipedicellata
Inga leptoloba
Inga Preussii
Inga Pittieri
Inga Rodrigueziana
Inga punctata
Inga Goldmanii
Inga Rensoni
Inga edulis
Inga oerstediana
Inga sciadodendron

Among them, *I. Goldmanii* has come in general use in coffee and cacao plantations in Costa Rica in recent times. It was not even known specifically in 1890, and is actually commonly seen shading such plantations on the Atlantic slope of that country.

As explained in the introduction, the species of Inga have gradually superseded other trees originally used as shade-trees and windbreakers in coffee plantations. It is likely that the Ingas began to come into prominence in Costa Rica about 1890. Up to that time, the trees used more extensively were two small-sized species of *Erythrina (E. costaricensis, E. rubrinervia)*, which, however, were objected to mainly on account of th danger of their prickles to the naked foot of the laborers, but also because, like all other species of the genus, they were despoiled of their foliage during the dry season. *Samanea*, which was at a time much in favor in Venezuela and other parts of South America, never was extensively used as a shade tree in Central America. On the Pacific watershed of Costa Rica, *Gliricidia sepium* was and is still the favorite in plantations situated below 1000 m., that is to say, at the lower edge of coffee cultivation; besides, it is often seen in the cacao plantations of the drier belt.

The Inga species have in their favor a permanent, not too thick foliage, a small size and a low branching which makes it possible to conveniently regulate and distribute the shade. Some species like *Inga Goldmanii, Rensoni, Preussii, Pittieri, rodrigueziana* and *edulis,* are given the preference in plantations located at low altitudes, while *I. laurina* (seldom used), *leptoloba, punctata* and *oerstediana* are used in the upper coffee-belt. Other species are met occasionally in the plantations. *Inga spuria* is avoided because short lived and subject to the attacks of insect pests.

It is possible that the role played by the Ingas as fruit trees has been underestimated; some of their larger pods with rich sweet pulp offer indeed real dietetic possibilities. All over Tropical America, these fruits are commonly seen in the markets and the fact that they have been used from the remotest antiquity as a food is also shown by their being found in Peruvian graves and by their having being reproduced in clay by the ancient pottery makers of South America[1]. The Venezuelan writer and traveler Michelena[2], celebrates in a few lines the exquisiteness of the *guamas* found by him in the village of Santa Isabel, on the Casiquiare, and describes the Inga tree in the middle of the plaza and the savorous pulp surrounding a single seed in a flat pod, etc. Such references are found in many other works and there are very encouraging reasons for paying more attention to this rather neglected fruit.

The pods of the following species are considered as edible in Central America:

Inga edulis *Inga spuria*	Pod of variable length (up to 1 m.) and thickness, terete, sulcate, twisted, not unlike a piece of rope.
Inga spectabilis	A very long and broad legume but rather flat, and with scarce pulp. Prized by the Bribri Indians of Costa Rica. Also cultivated in Panamá, where the pods are unusually long (up to 75 cm.) and broad.
Inga radians *Inga paterno*	The first species has large green pods in which the transversally placed seeds are surrounded by a copious aril. In the latter species, the pods are smaller. When in season, an important addition to the fruit market in Guatemala City.

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[1] Safford—Proc. Nineteenth Congress of Americanists (December, 1915) p. 17. 1917.
[2] Michelena y Rojas—Exploración oficial etc. 1867—p. 854.

Inga punctata *Inga laurina* *Inga marginata* *Inga aestuariorum* *Inga ruiziana*	Small pods, with a more or less abundant and perhaps more palatable pulp.
Inga mucuna	Species with broad hairy pods, the pulp of which is relished by the Choco Indians of Panamá.
Inga rensoni	Hairy, broad pods, the sweet pulp of which is a favorite among the natives of San Salvador.

SPANISH VERNACULAR AND NATIVE NAMES

On account of the many errors in the identification of the species, and also of the general lack of discrimination in the use of common names, it is somewhat difficult to give a correct list of such names. In preparing the following list, I have had to reject practically half of the materials originally brought together. What is left may be considered as a rule to correspond to the right specific names. Because of the importance of several species of this interesting group as shade or fruit trees, it is to be hoped that a further effort will be made to eventually straighten and increase the list.

Inga Jinicuil Schlecht—MEXICO: *Jinicuil,* used in the area of dispersion of the species. The derivation seems to be from the nahualtl *xini*, to fall, to hang, and *quilitl*, a shoot, here by extension a pod, the meaning being therefore, (the tree with) hanging, pendent pods. *Cuajiniquil, cujiniquil* or *guajiniquil* (see below) is an ampliation, the prefix *cua* or *cu* corresponding to *quauitl*, a tree, thus: the tree with hanging pods.

Inga Paterno Harms—*Paterno,* o *paterna,* in GUATEMALA and SALVADOR, Etymology unknown.

Inga radians Pittier—*Cujiniquil* in Tapachula (Cook); *paterno* in Guatemala; *guavo real* in COSTA RICA, where the tree is sometimes cultivated, having been brought from Guatemala.

Inga marginata Willd—Sometimes *sotacaballo* in Costa Rica, where however this name applies more generally to *Pithecolobium cognatum.* It is the *buk-u-dra* of the Guaimi-Indians.

Inga laurina Willd—In the kekchi language of Alta Verapaz, the pods of this tree, as well as those of *I. leptopoda,* are called *butz-chachuk*, according to O. F. Cook.

Inga leptoloba Schlecht—See under *I. laurina* and *I. punctata.*

Inga punctata Willd—This species, as well as the anterior and several others, is known in Costa Rica under the generic name of *guavo,* which becomes *guamo* in NORTHERN SOUTH AMERICA.

This same species is also called *cuajiniquil blanco* and *ixcapirol* in Guatemala.

Inga ruiziana G. Don.—*Toparejo* in the Choco language of SOUTHERN PANAMÁ.

Inga Mucuna Walp. & Duch.—*Guavo peludo* in PANAMÁ, a name applied in that country and Costa Rica to all the species with broad hairy pods. *I. Mucuna* is also the *mimi-sajo* or *mimi-sojo* of the Choco Indians.

Inga spectabilis Willd.—*Guavo machete* in COSTA RICA, on account of the likeness, in size and shape, with the sheathed bush-knife in common use among the natives. It is also the *guavo real* of Panamá. In Bribri *se-ui*, in Térraba *u-gruók*, in Brunka *guarogua*, in Dorasque *suliapó*, in Guaimi *buk-e-kré*.

Inga Rensoni Pittier—*Quijinicuil* or *cujin* in SAN SALVADOR (Renson).

Inga Preussii Harms—*Cuxiniquil* (Preuss); *nacaspil* (Pittier) in SAN SALVADOR. *Cuxiniquil* is the pipil form, much closer to the original nahuatl; *nacaspil* is also of pure Mexican derivation and may be misapplied here, if the meaning is *nacas*, ear, with the diminutive suffix *pil*.

Inga Rodrigueziana Pittier—*Chalun colorado* in Chiapas, MEXICO according to Popenoe. The name *chalahuitl* for *I. spuria*, seems to indicate that *chalun* is also of nahuatl derivation.

Inga edulis Mart.—The BRAZILIAN name of this species, *Inga cipo*, is the origin of the generic name used in scientific classification. It is the *guavo-bejuco*, or *guavo torcido*, so-called on account of its long, twisted pods, of several parts of Southern Central America, and the *guavo mecate of* Mexico. *Suremná, se-ui* in Térraba; *tseuib-ua* in Brunka.

Inga oerstediana Benth.—*Guavo* in WESTERN PANAMÁ.

Inga spuria Humb & Bonpl.—SOUTH-MEXICO: *vainillo* (Kerber); *chalahuitl* (Pringle). Guatemala; (Heyde & Lux); Costa Rica, *cuajiniquil* (Pittier); *ataña* in Bribri, *xuín* in Térraba, *brudji-ua* o *vainica* in Brunka (Pittier), *buk-óro-mo* in Guaimi.

Inga eriocarpa Benth.—MEXICO; *bainillo, vainillo* (Langlassé).

Inga xalapensis Benth.—MEXICO: *cuajiniquil* (Jalisco, Safford).

Inga Sciadodendron—Harms—MEXICO: *chalauitl* (Veracruz, Purpus).

Inga oophylla Riley—*Vainillo* (Sinaloa, González).

Inga fissicalyx Pittier—MEXICO; *Bitz, chelele, guatope* (Tabasco, Rovirosa).

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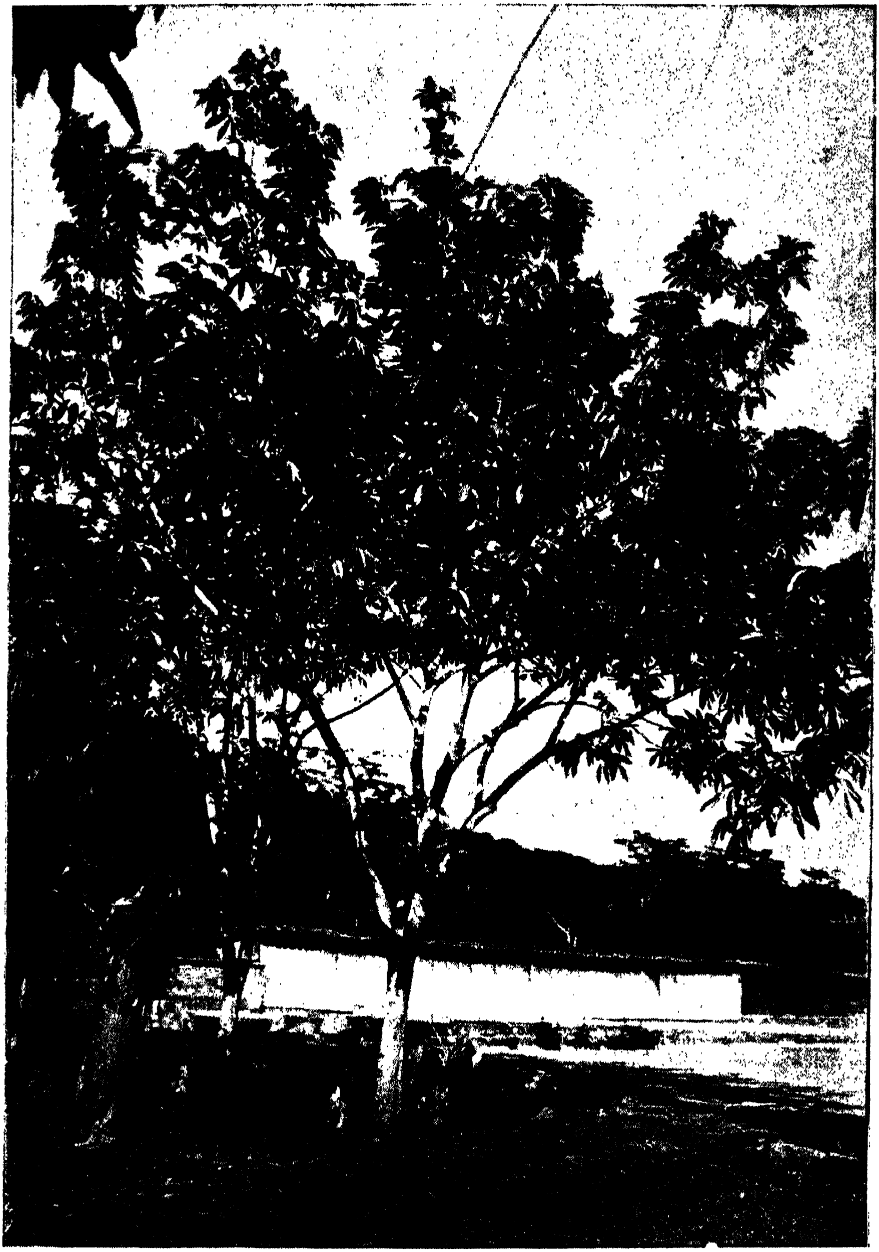
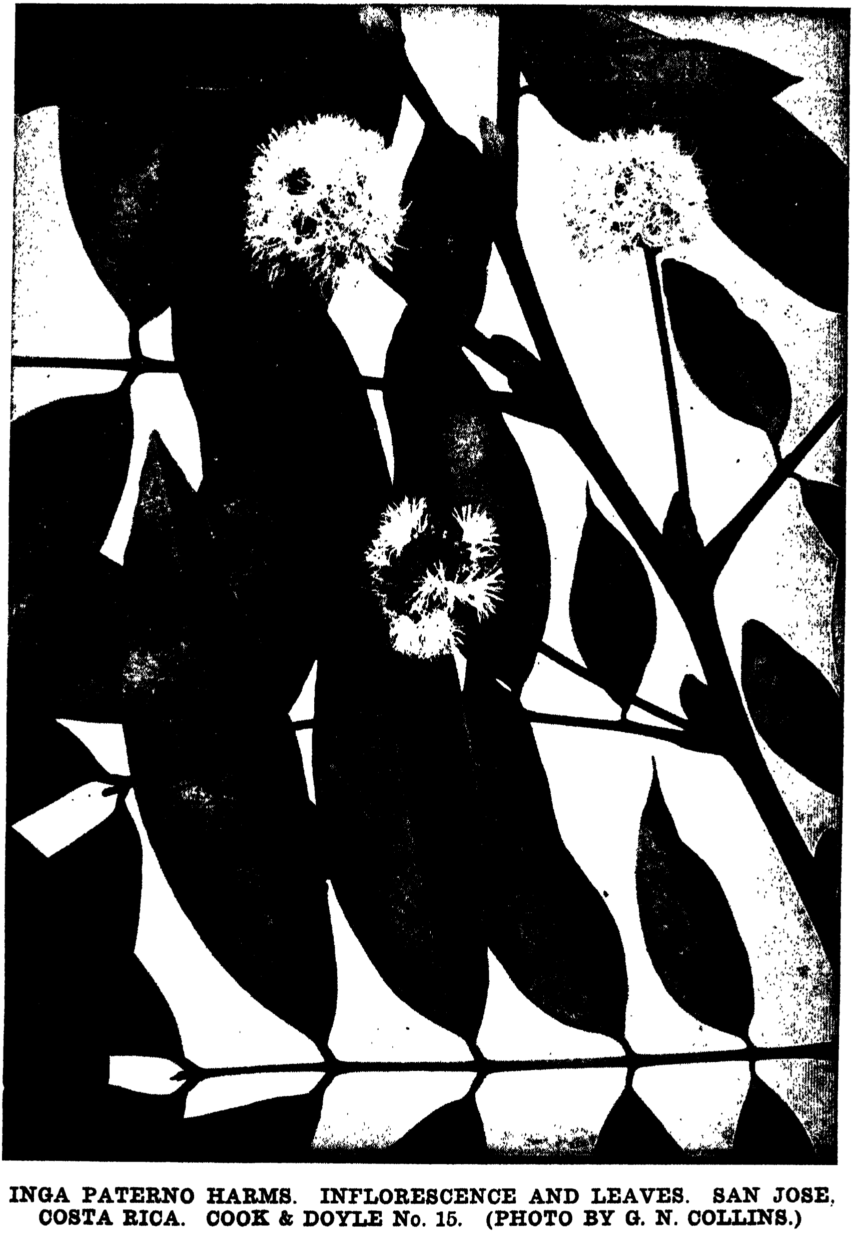
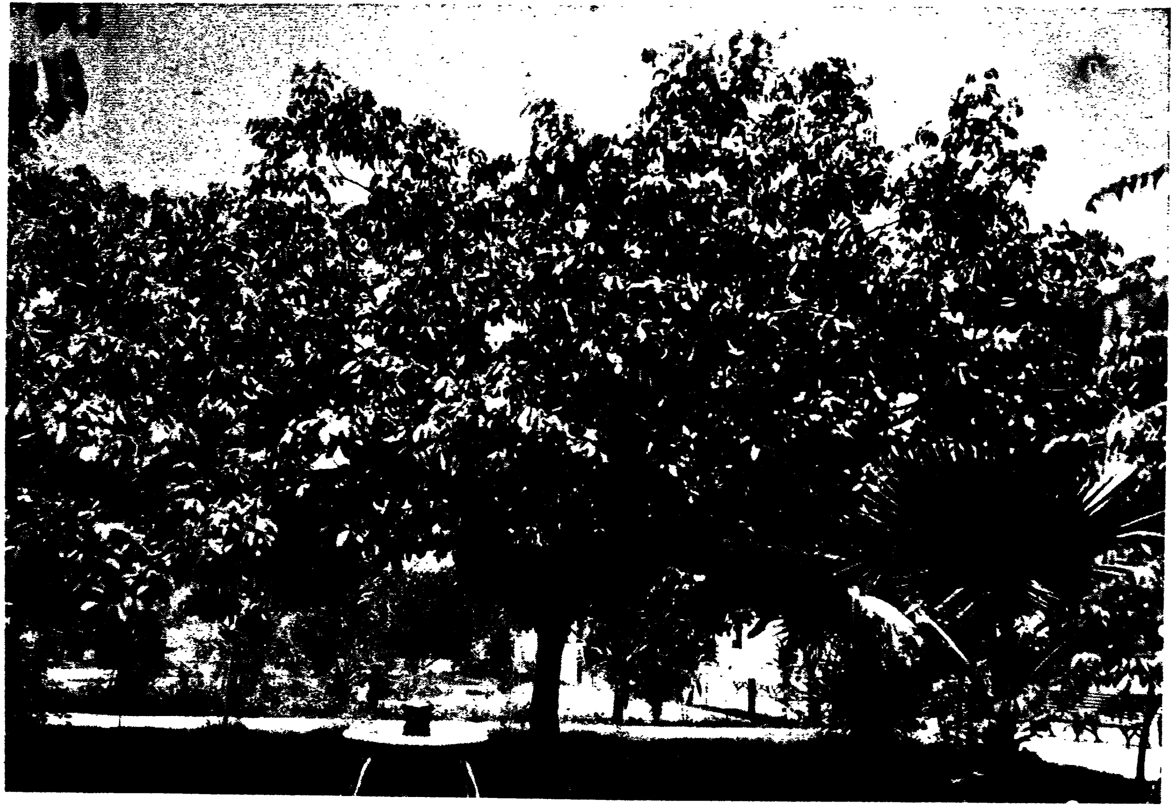


INGA PATERNO HARMS. A TREE NEAR SAN JOSE, COSTA RICA.
COOK & DOYLE No. 15. (PHOTO. BY G. N. COLLINS.)



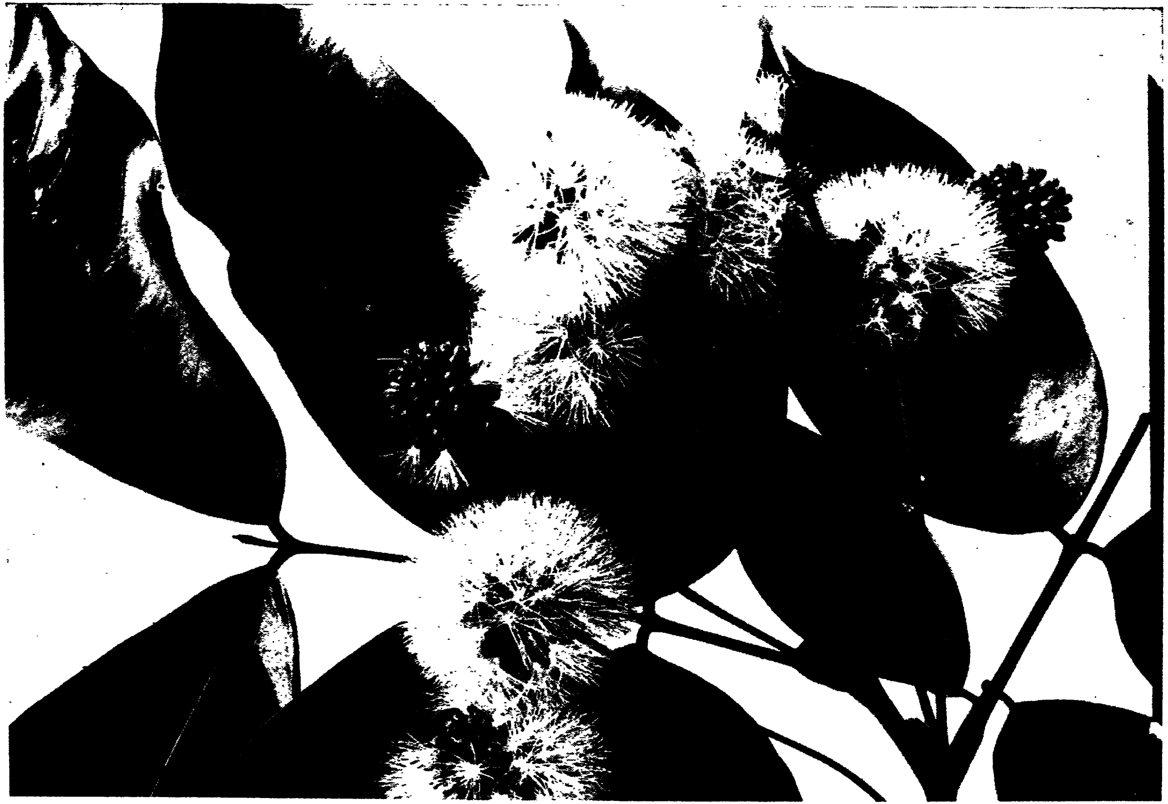
INGA PATERNO HARMS. INFLORESCENCE AND LEAVES. SAN JOSE, COSTA RICA. COOK & DOYLE No. 15. (PHOTO BY G. N. COLLINS.)

PLATE XV.



INGA RADIANS PITTIER. A TREE IN TAPACHULA, CHIAPAS, MEXICO. (O. F. COOK 805)
PHOTO. BY G. N. COLLINS.

PLATE XVI.



INGA RADIANS PITTIER. INFLORESCENCES AND LEAVES. (O. F. COOK No. 805.)
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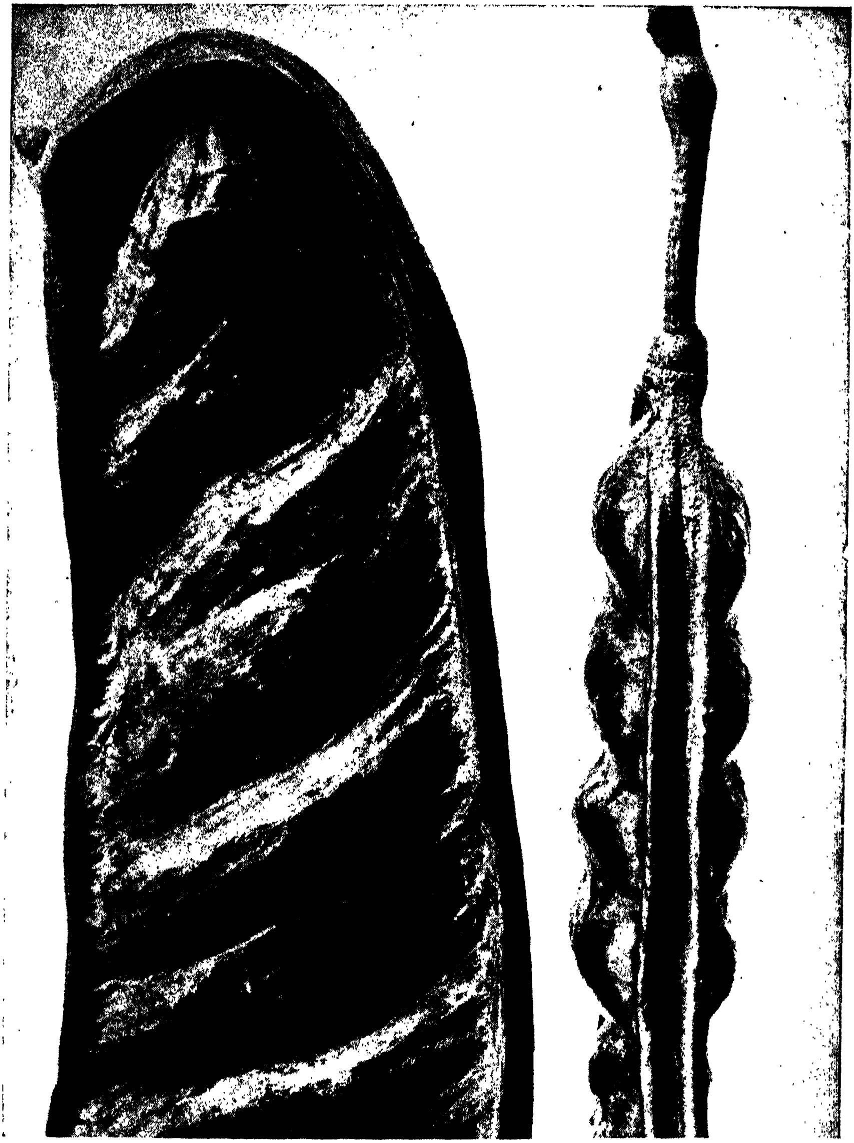
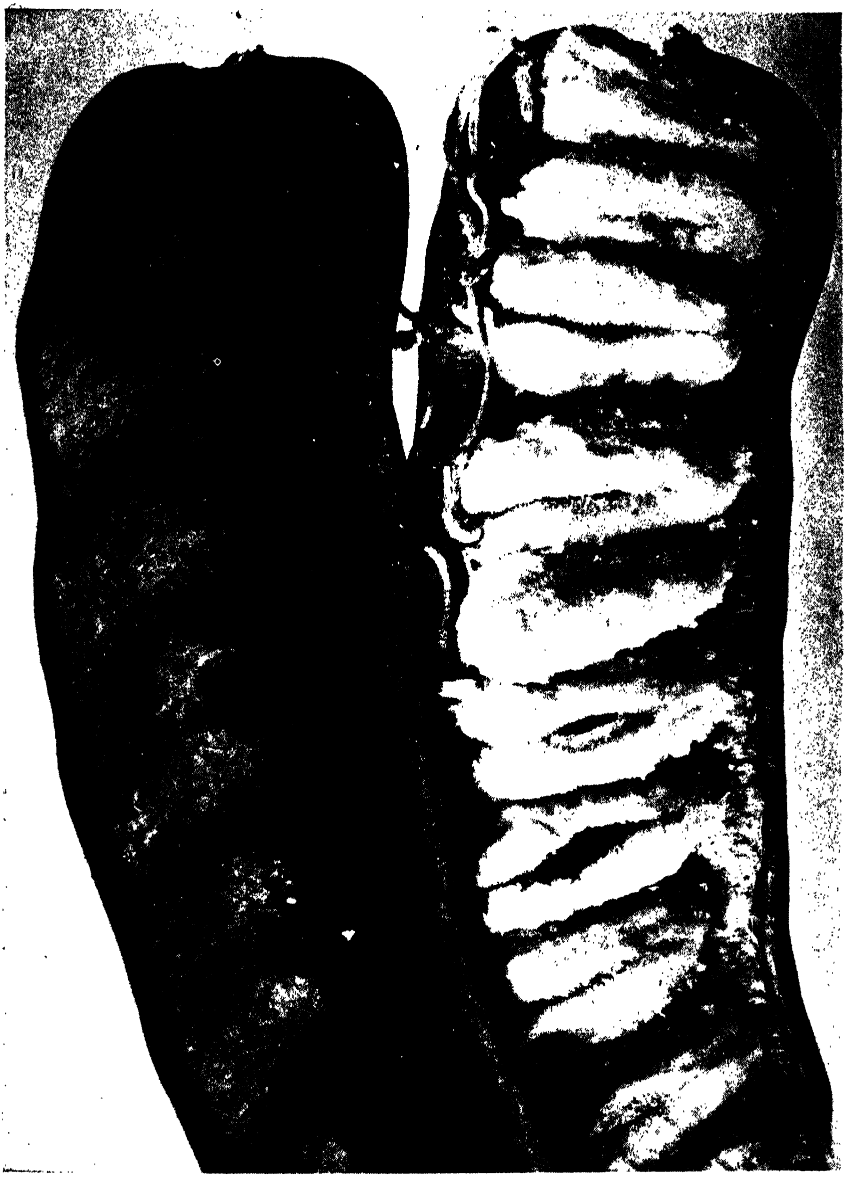
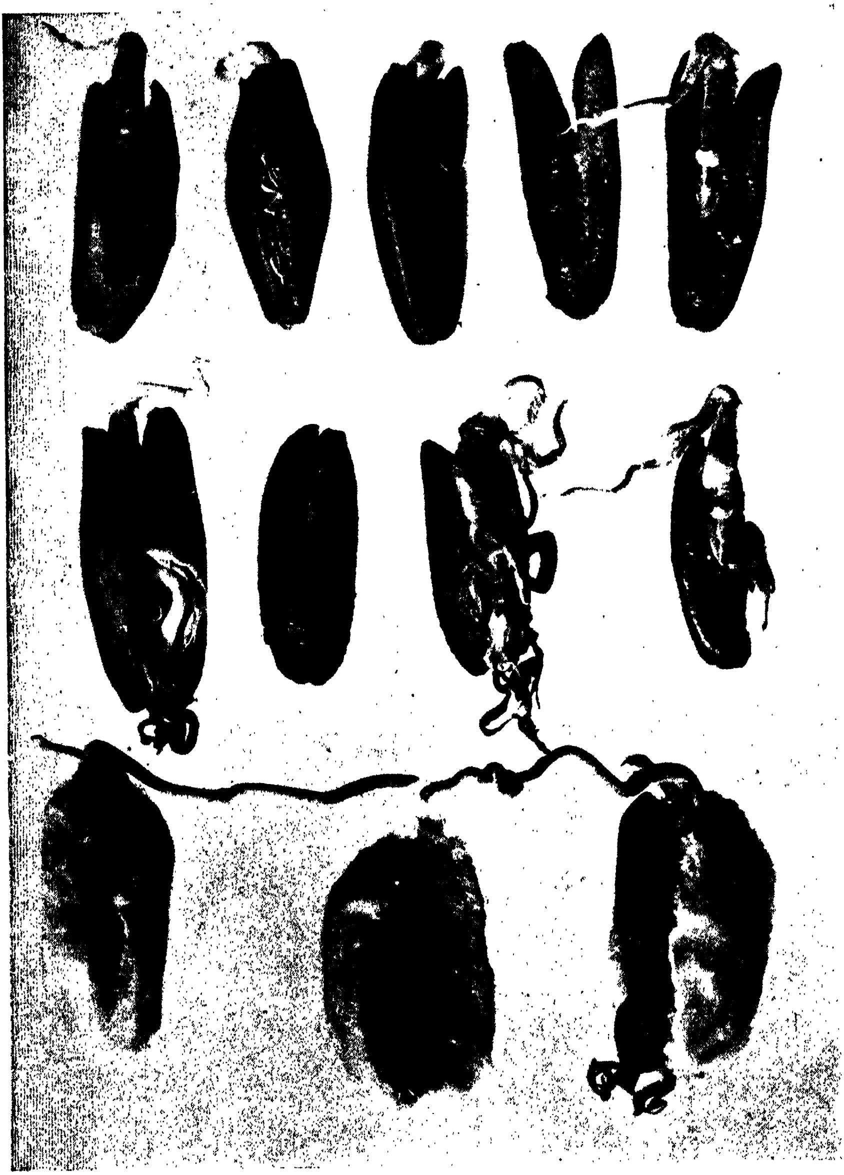


INGA RADIANS PITTIER. PODS, FRONT AND PROFILE. TAPACHULA, CHIAPAS, MEXICO. (PHOTO. BY G. N. COLLINS.)

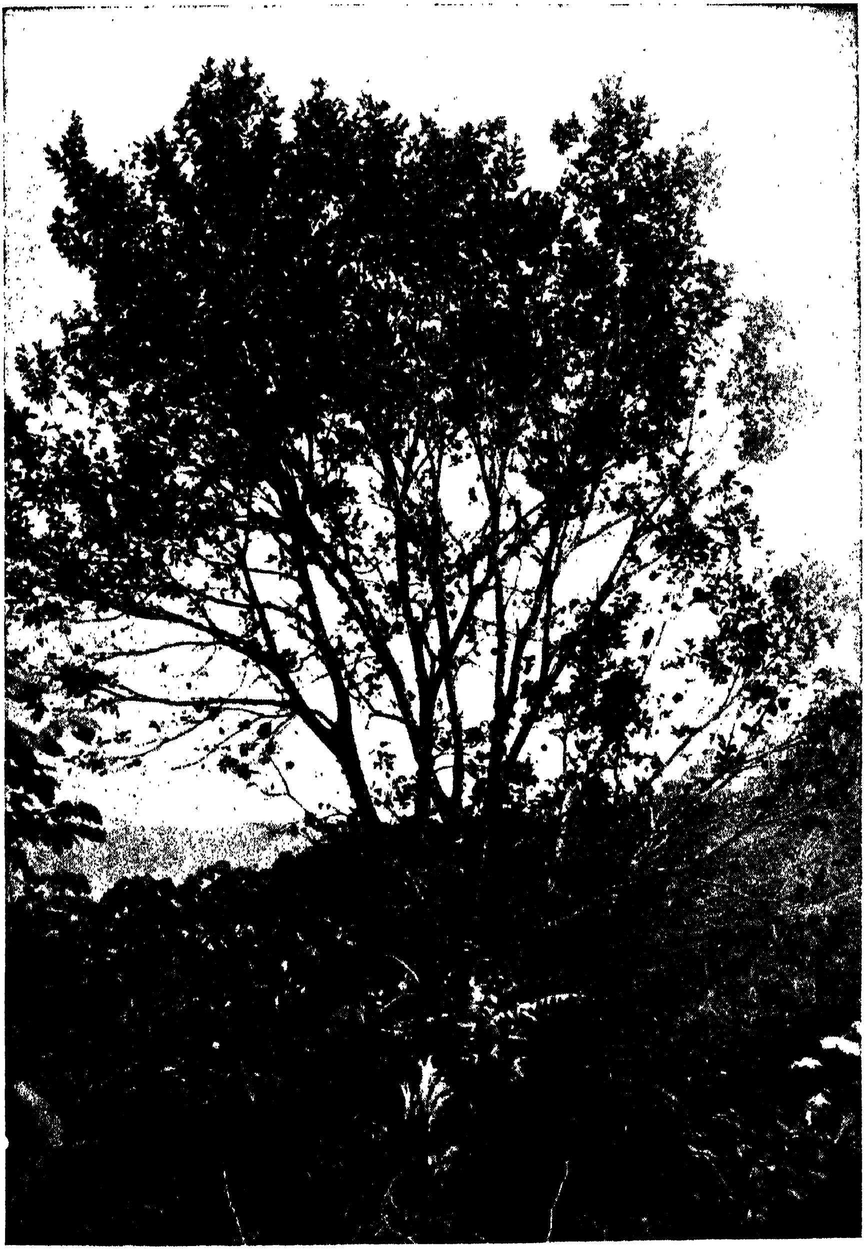
PLATE XVIII.



INGA RADIANS PITTIER. POD OPEN AND SHOWING WHITE PULP AROUND THE SUDS. TAPACHULA, CHIAPAS, MEXICO. (PHOTO. BY G. N. COLLINS.)

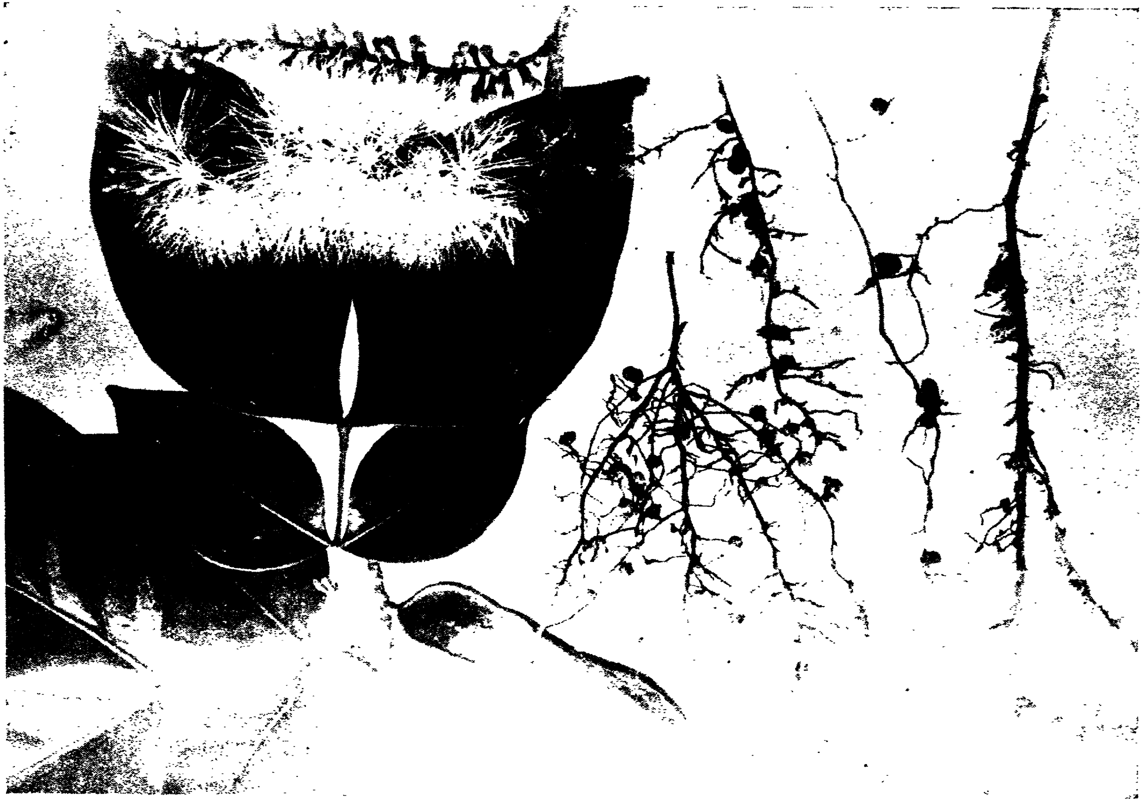


INGA RADIANS PITTIER. GERMINATING SEEDS. TAPACHULA, CHIAPAS, MEXICO. (PHOTO. BY G. N. COLLINS.)



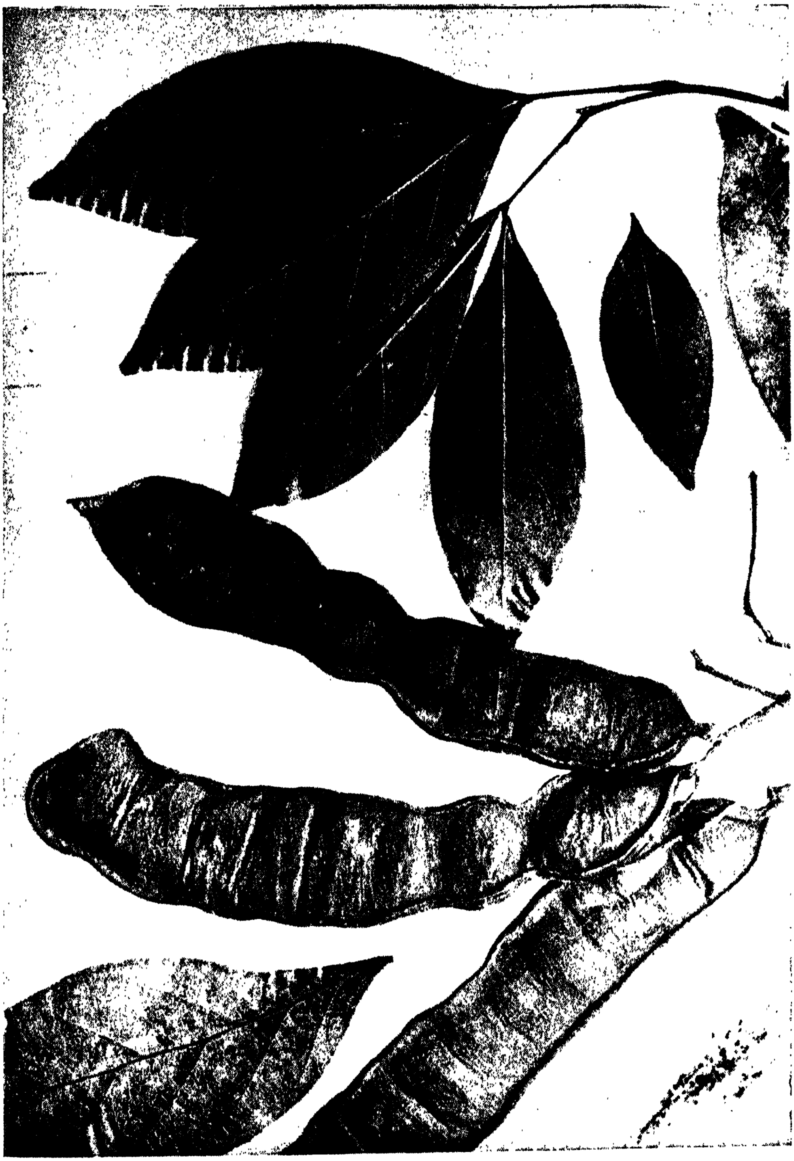
INGA LAURINA WILLD. A TREE IN COFFEE PLANTATION, PORTO RICO.

PLATE XXI.

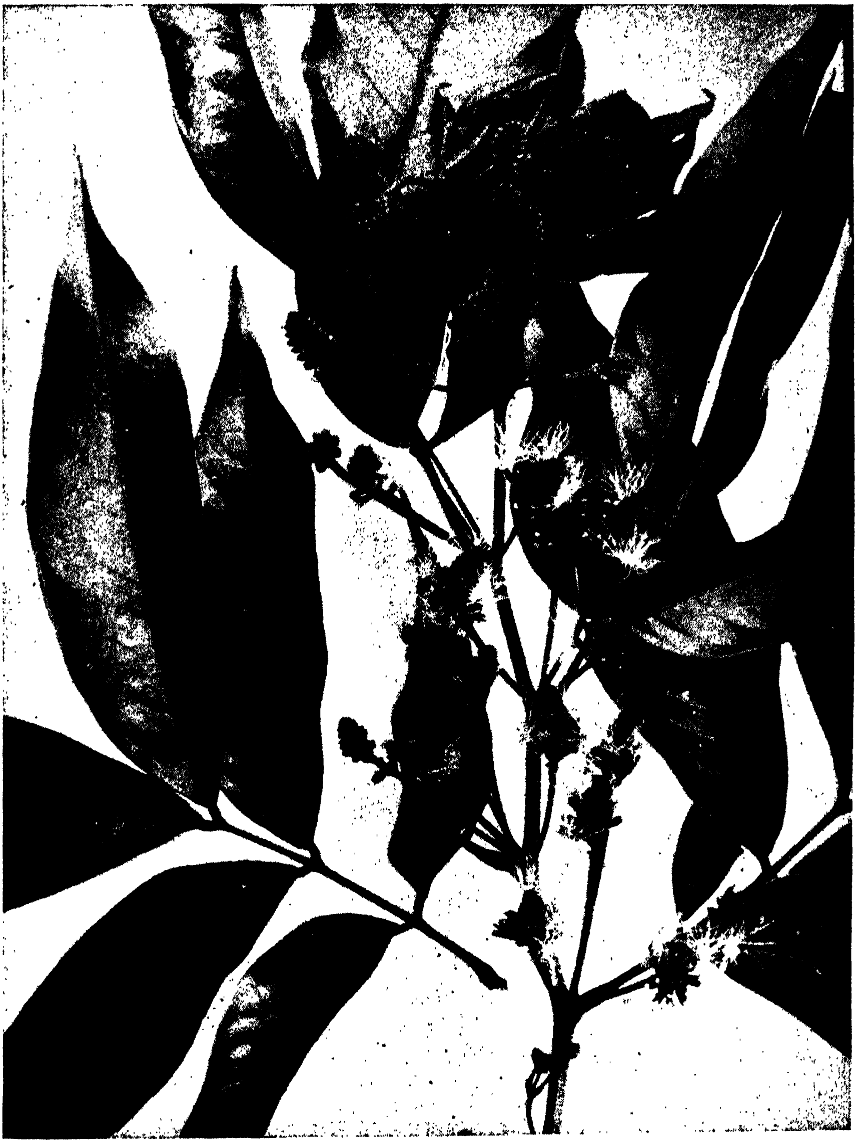


INGA LAURINA WILLD. FLOWERS, LEAVES, YOUNG POD AND NODULES ON THE ROTLETS. NATURAL SIZE. PORTO RICO. (PHOTO. BY G. N. COLLINS.)

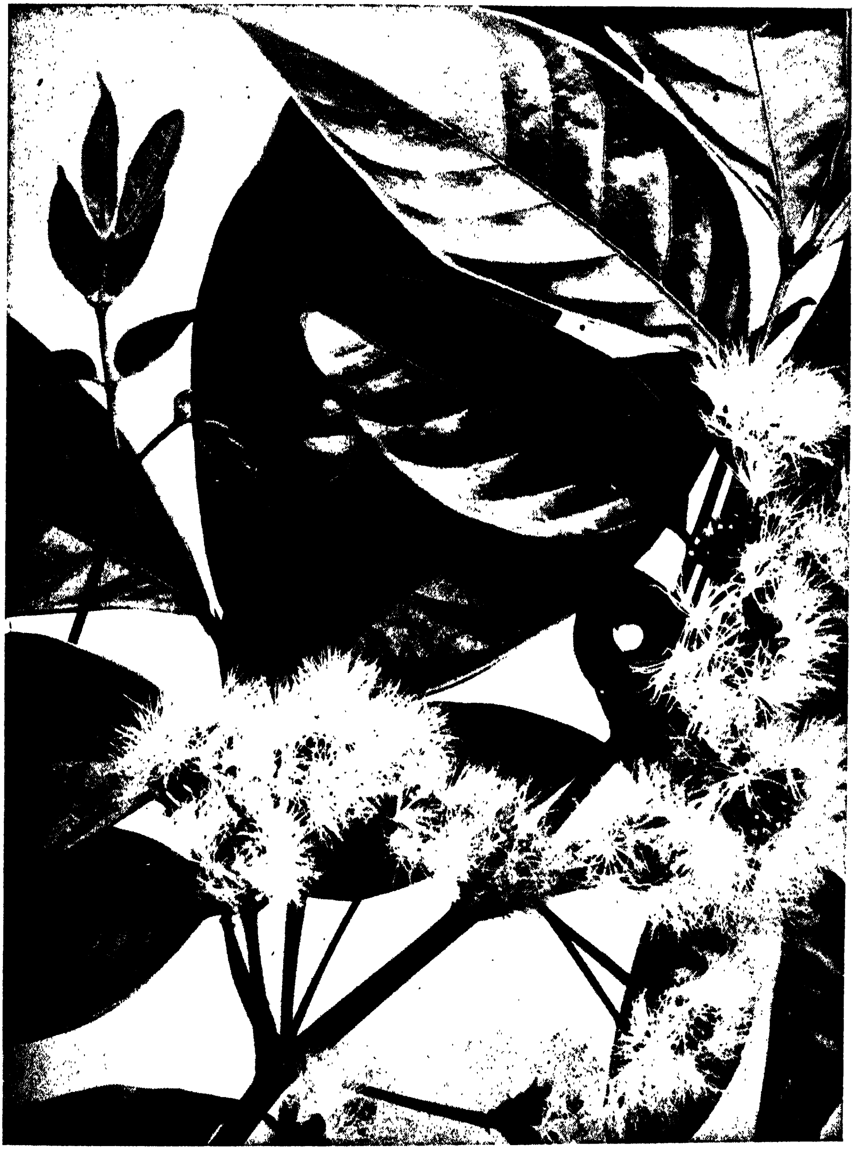
PLATE XXII.



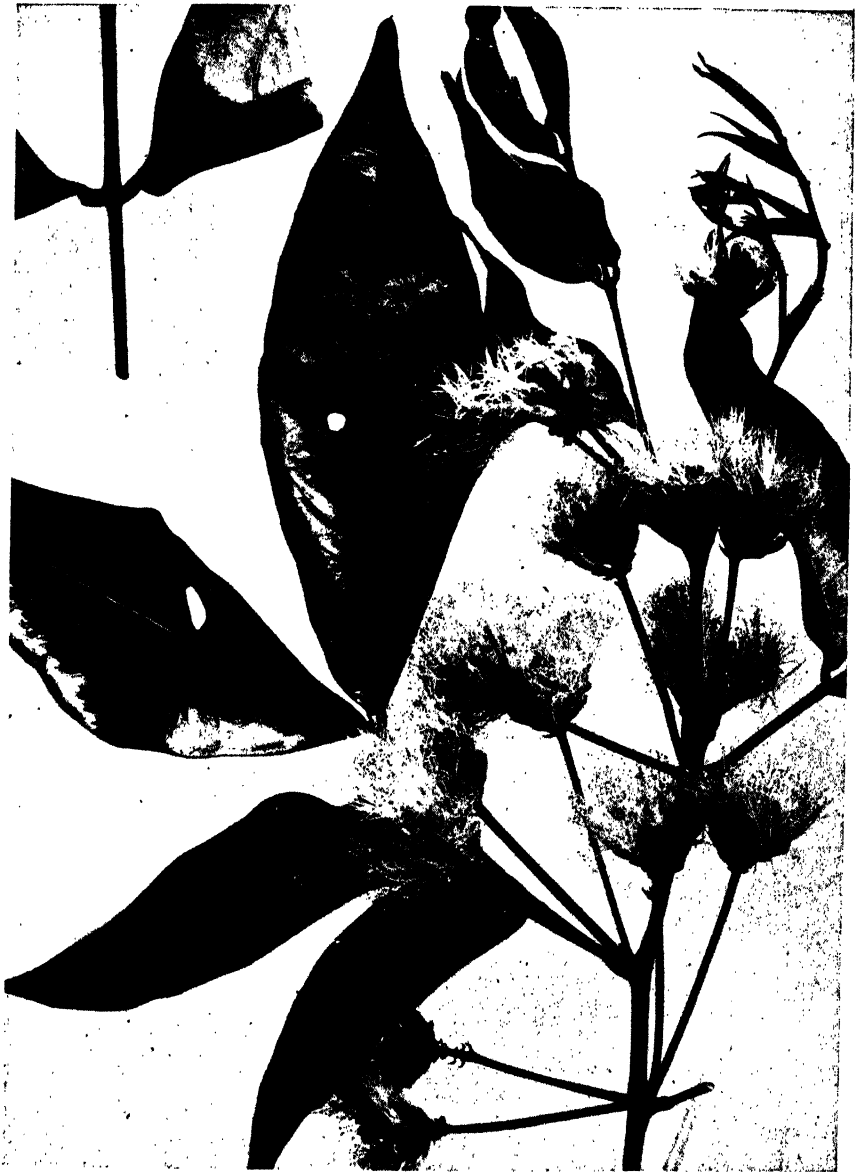
INGA LAURINA WILLD. LEAVES AND NATURE PODS. PORTO RICO.
(PHOTO. BY G. N. COLLINS.)



INGA LEPTOLOBA SCHLECHT. FIRST STAGE OF FLOWERING; SHOWING ALSO NEXTARY GLANDS AND DETAILS OF LEAF. N. S. FROM COOK & GRIGGS SPECIMEN No. 51, ALTA VERAPAZ. (PHOTO. BY G. N. COLLINS.)

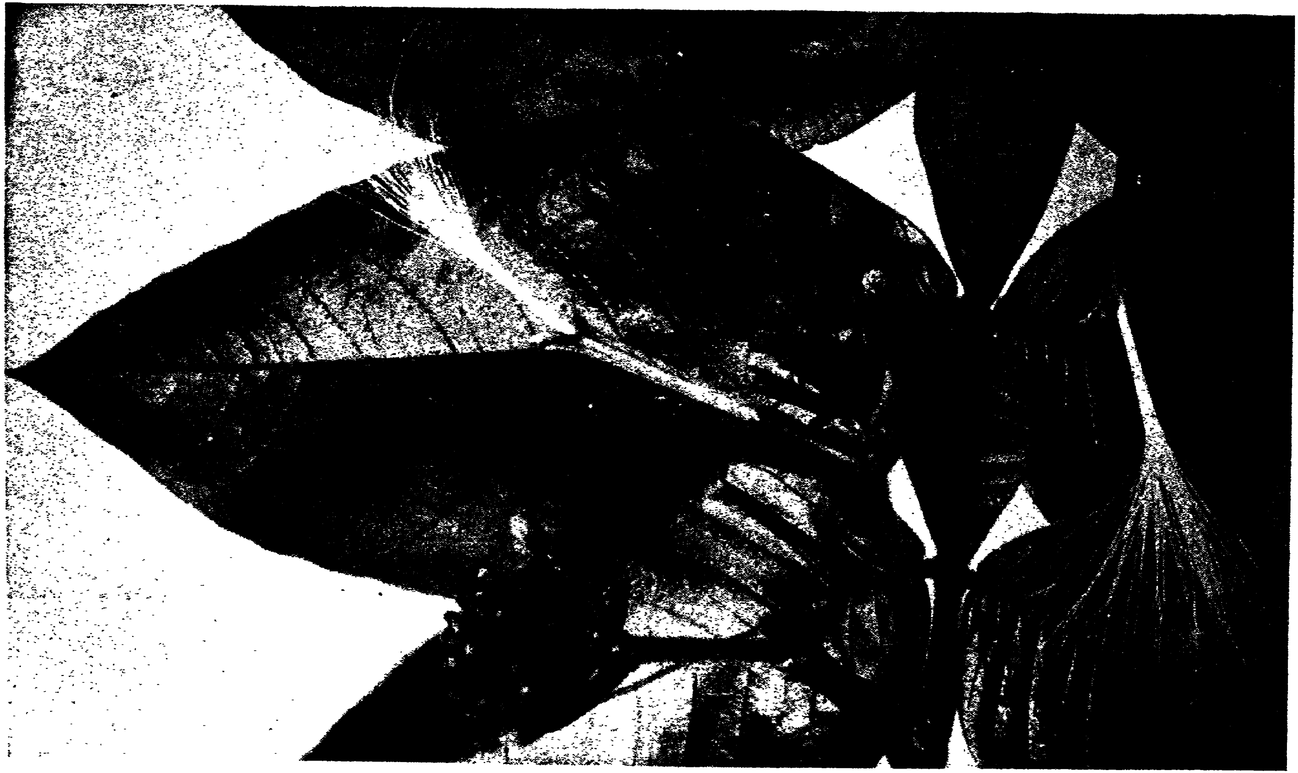


INGA LEPTOLOBA SCHLECHT. ADVANCED STAGE OF FLOWERING.
FROM COOK & GRIGGS SPECIMEN No. 53, ALTA VERAPAZ.
(PHOTO. BY G. N. COLLINS.)



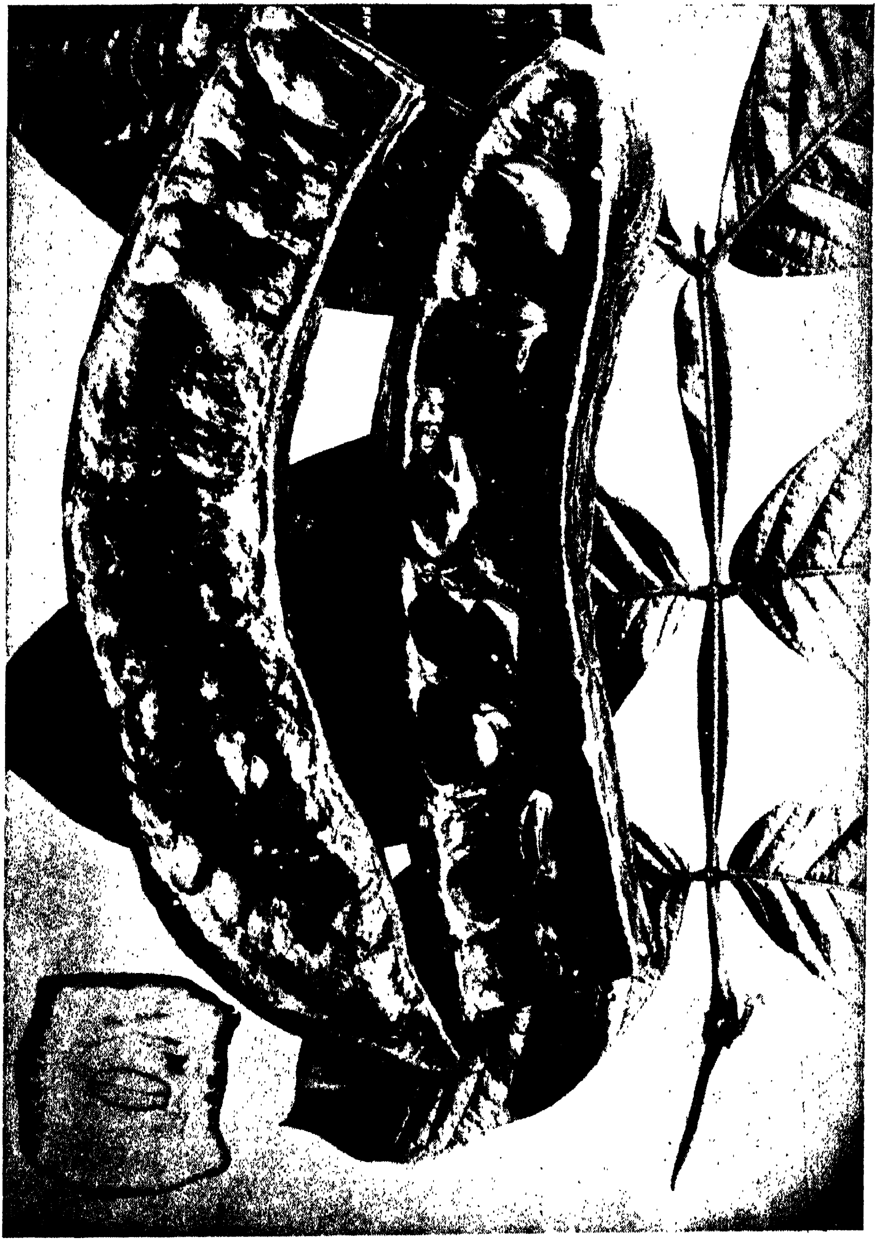
INGA LEPTOLOBA SCHLECHT. FULL BLOOM WITH PART OF LEAF SHOWING GLAND IN UPPER LEFT CORNER. FROM COOK & COLLINS SPECIMEN No. 53. ALTA VERAPAZ. (PHOTO. BY G. N. COLLINS.)

PLATE XXVI.

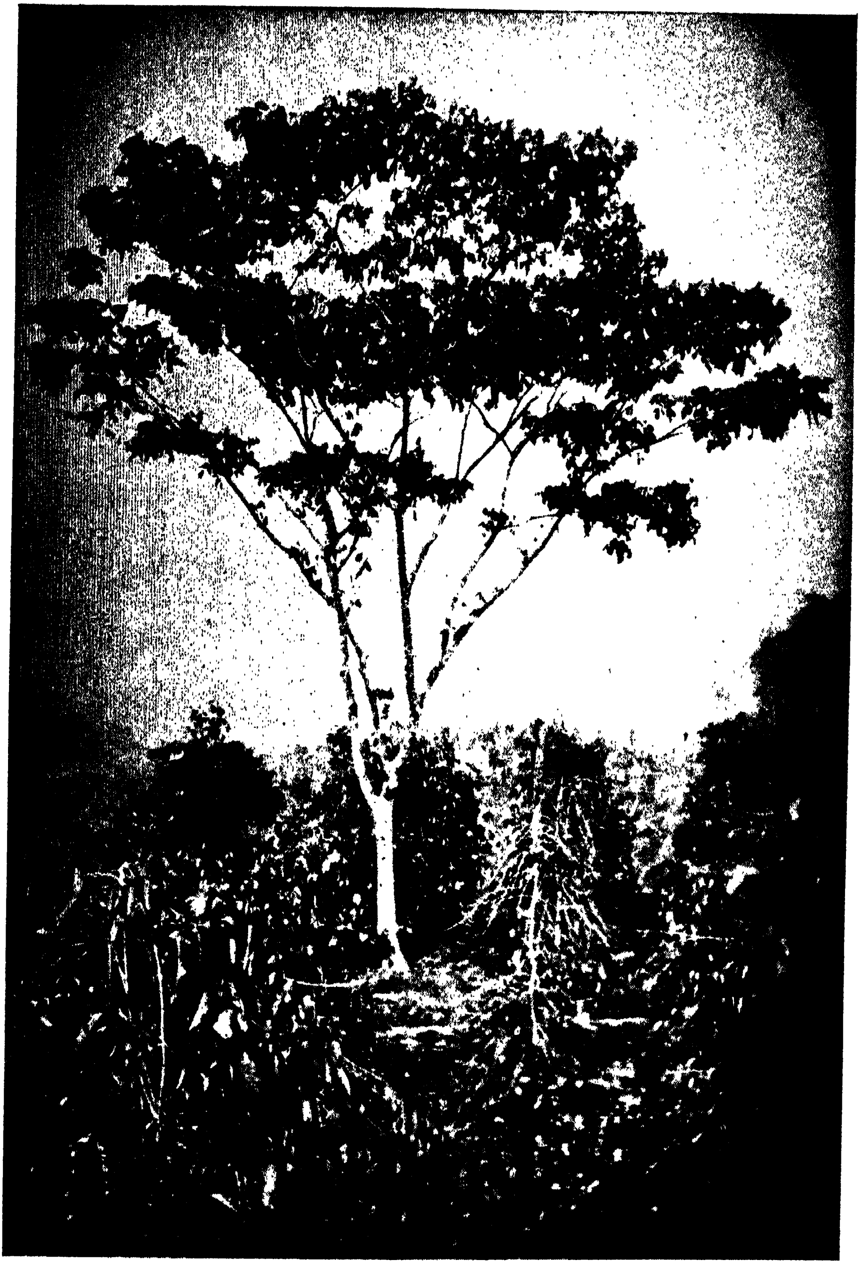


INGA MUCUNA WALP. & DUCHASS. FLOWERS AND LEAFLETS. FROM PITTIER'S SPECIMEN No. 5525. SOUTHERN PANAMA. (PHOTO. BY H. PITTIER.)

PLATE XXVII.

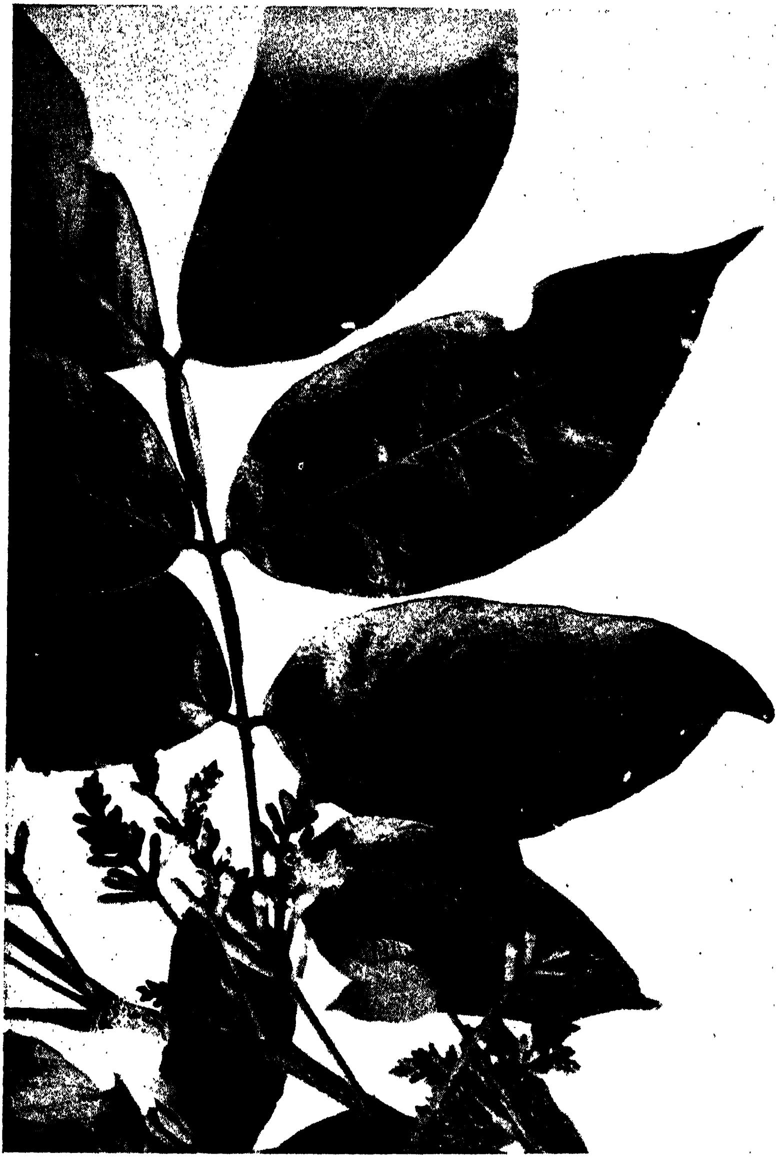


INGA PREUSSU HARMS. POD AND LEAF. LA CONCEPCION, GUATEMALA. (PHOTO BY G. N. COLLINS.)

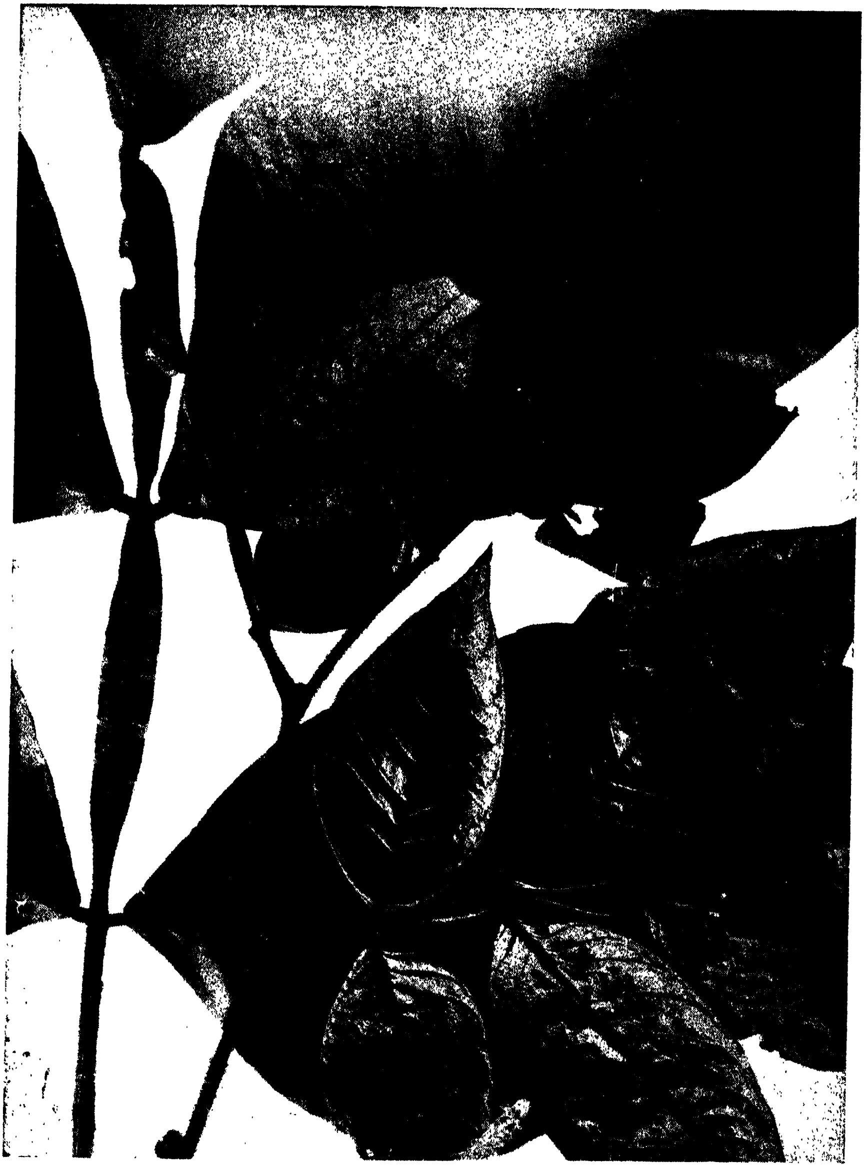


INGA EDULIS MART. A TREE IN COFFEE PLANTATION AT SEPACUITÉ, GUATEMALA. (PHOTO. BY G. N. COLLINS.)

INGA EDULIS MART. LEAVES SHOWING NECTARY GLANDS AND INFLORESCENCES IN PREFLOWERING STAGE. FROM COOK'S SPECIMEN No. 124 COLL. AT SEPACUITÉ, GUATEMALA. (PHOTO. BY G. N. COLLINS.)



INGA EDULIS MART. FLOWERING BLANCHLET AND LEAF. COOK & GRIGGS SPECIMEN No. 228, SEPACUITÉ, GUATEMALA. (PHOTO. BY G. N. COLLINS.)



INGA COOKII PITTIER IN FOREGROUND. COOK & GRIGGS No. 226; INGA EDULIS MART. IN BACKGROUND, BUT SPECIMEN APPARENTLY NOT IN HERBARIUM. BOTH FROM SEPACUITÉ, GUATEMALA.

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PHYTOPATHOLOGICAL SURVEY OF SANTO DOMINGO.

By

R. CIFERRI

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PHYTOPATHOLOGICAL SURVEY OF SANTO DOMINGO, 1925-1929

By R. CIFERRI
Director, National Agronomic Station and College of Agriculture, Moca, D. R.

INTRODUCTION

The scope of the present survey is limited to the most important diseases of plants of economic value which have so far been discovered in the Dominican Republic. Therefore we have prepared only a list of said diseases with remarks on the damage caused by the principal ones. Where no mention is made of the localities or geographical areas, it is understood that the disease is found practically in any place where the plant affected by the disease is grown, but in cases where the disease is restricted to a limited area, this fact is mentioned. The phytopathological survey of the Dominican Republic was started over four years ago and has been continued uninterruptedly to date. Our survey does not include diseases which affect plants recently introduced, or those grown for experimental purposes, or cultivated sporadically, neither does it deal with those which attack ornamental plants, except in a very few cases.

MYCOLOGICAL AND PHYTOPATHOLOGICAL SURVEYS

The first two phytopathological surveys in Santo Domingo, dealing only with sugar cane diseases were made by Johnston (**14**) and Stevenson (**15**) who in 1913 and 1917 identified almost all cane diseases and collected twenty-one different fungi on cane. In 1923 Faris published two papers; one on sugar cane diseases which was very complete (**12**) and the other on different cultivated plants (**13**), the latter being the first general phytopathological survey published to date. Although Faris, owing to his brief stay in Santo Domingo, was unable to identify all the principal diseases which affect the cultivated plants he at least succeeded in classifying those of greatest economic importance. The author mentioned in the Annual Reports for the years 1925, 1926 and 1927 (**3**) of the Agronomy Station of Haina, later of Moca, some of the diseases discovered by him and in addition published a series of papers on the subject (**4**, **5**, **6**, **7**), and also on the smuts of Santo Domingo. González Fragoso and the writer also published from 1925 to 1928, a series of sixteen mycological contributions (**10**) which comprised about five hundred species, among which there were some of economic importance. The fungi so far studied appeared in a general treatise or check list of the microflora of the Dominican Republic (**9**) published in 1928. Mention should also be made of four important contributions to mycology, one by Kern (**16**) deals with species of rusts some of which are of economic importance; another by Toro (**17**) is a study of several groups of fungi; and two papers by Carlos E. Chardon on American Dothideales (**1**, **2**).

While mycological investigations in Santo Domingo cover a comparatively limited area, the phytopathological survey is more extensive, especially as regards to the chief cultivated plants. However, it is interesting to note that the principal agricultural areas of Santo Domingo devoted to cacao, coffee, tobacco, fruit trees and minor crops which include chiefly the Valley of the Cibao, the sugar cane district of the eastern part and the northwestern region under irrigation were the chief centers of investigations and thorough survey work.

AGRICULTURAL PRODUCTION OF SANTO DOMINGO

Santo Domingo is by far an agricultural country. Exports during the decade 1919–1928 ranged from a minimum of $15,231,355 (in 1922) to a maximum of $58,731,241 with a yearly average of $30,208,403 of which over 99 per cent corresponds to agricultural products or products derived from agricultural industries. During the fiscal year 1928 * the percentage of exports was as follows:

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* Adapted from the Report of the 22nd fiscal period, Dominican Customs Receipts (1928), Washington, 1929.

	Agricultural products %	Other products %	Total
1. Sugar and sugar cane	64. 28	------	-------
2. Cacao	14. 78	------	-------
3. Coffee	7. 43	------	-------
4. Tobacco and manufactures	4. 69	------	-------
5. Animal products	3. 47	------	-------
6. Molasses	2. 15	------	-------
7. Corn	1. 11	------	-------
8. Woods	0. 79	------	-------
9. Beans and seeds	0. 13	------	-------
10. Fruits	0. 10	------	-------
11. Shells, tannics, etc.	0. 08	------	-------
12. Dyes and resins	0. 03	------	-------
13. Other vegetable products	0. 31	------	99. 39
14. Marine products	-----	0. 02	-------
15. Mineral products	-----	0. 01	0. 03
16. (Reexports)	-----	------	(0. 58)
Total	99. 39	0. 03	100. 00

For the purpose of this survey, the author has made the following zone or area divisions of Santo Domingo.

1. Zone of the central range of mountains largely covered by extensive natural groves of pines.

2. Zone of the north range of mountains partly planted in coffee, minor fruits, and sugar cane to a very limited extent, and partly devoted to cattle raising.

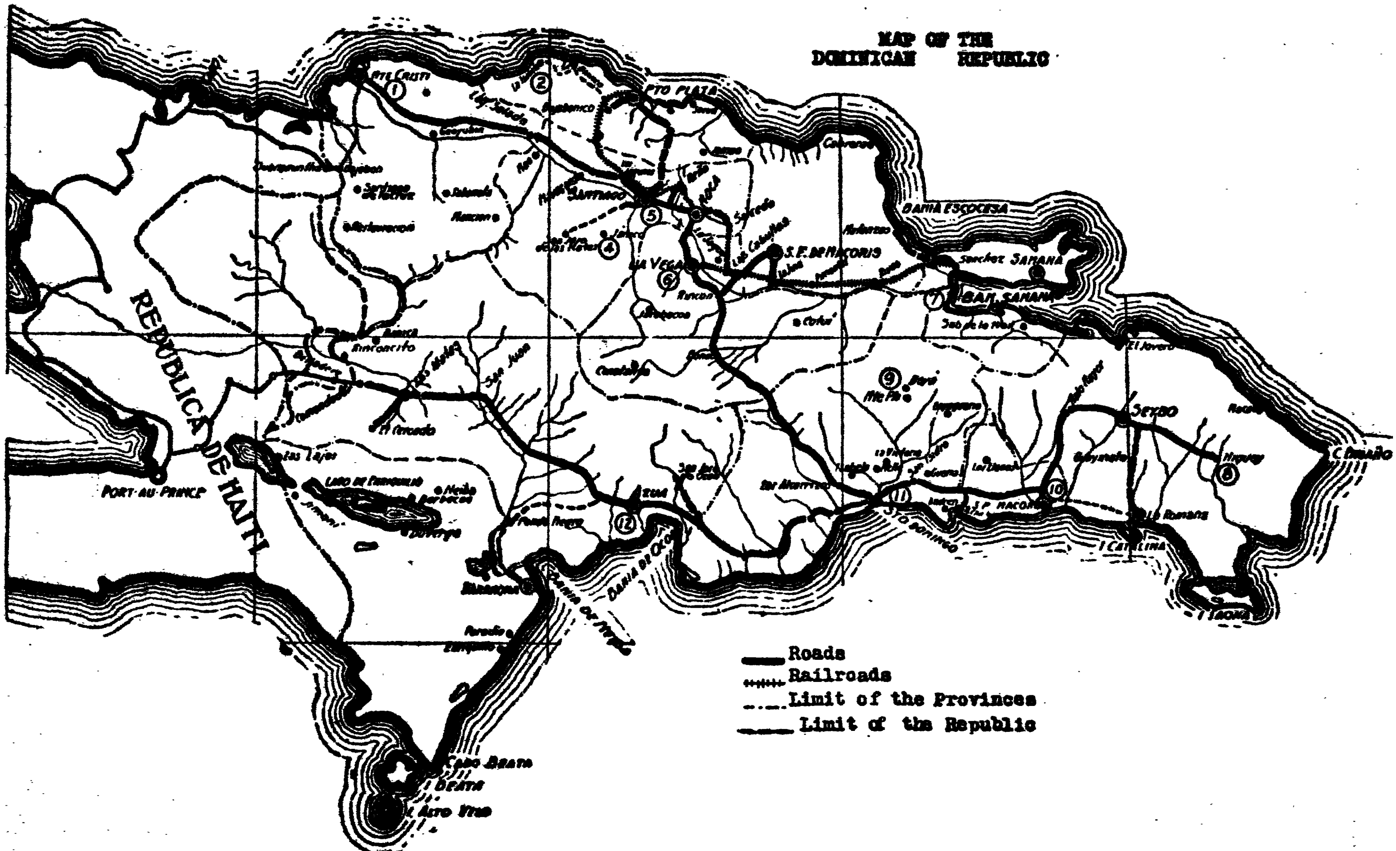
3. Valley of the Cibao, which is the most fertile area and consequently the most intensively cultivated district in Santo Domingo. It produces the largest portion of the agricultural products, not including sugar cane (especially cacao, tobacco, corn, beans, coffee, etc.)

4. Barren regions of the northwest and southwest, which formerly produced cotton and are at present devoted to hard wood, small quantities of vegetable dyes and tannics and the raising of goats.

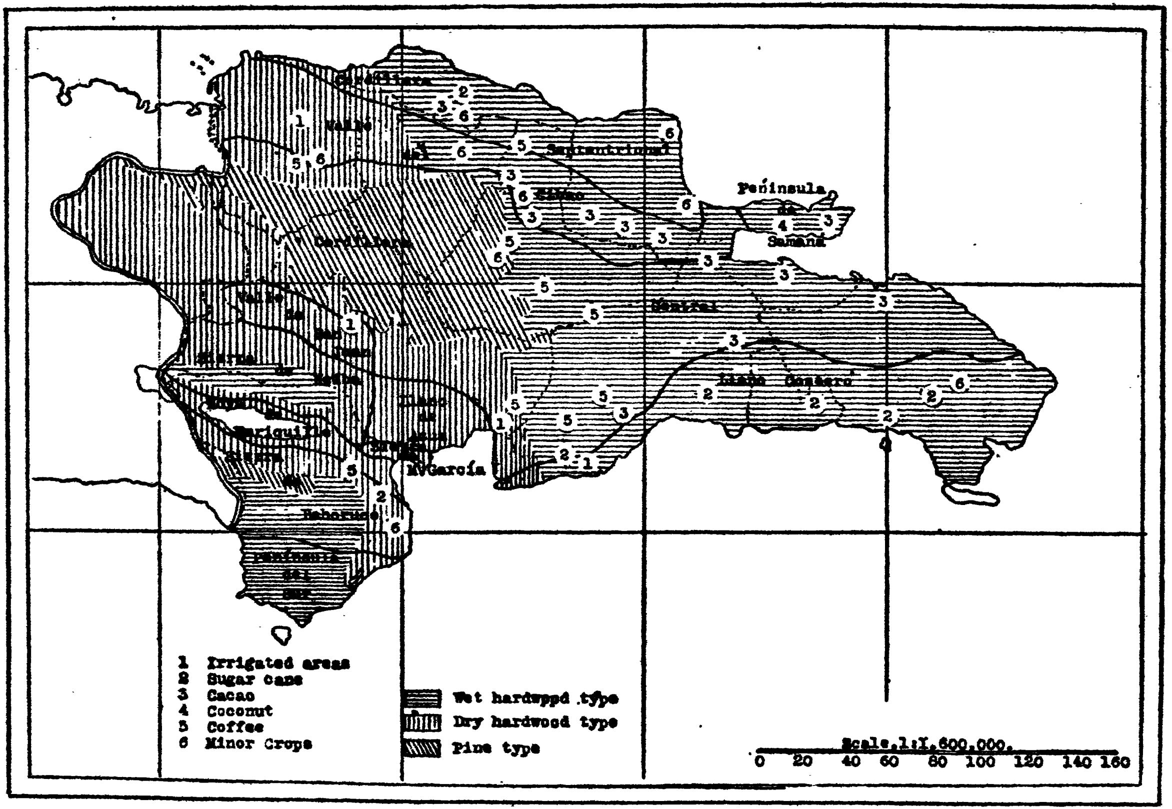
5. Irrigation areas of the northwest and southwest, chiefly devoted to potatoes, rice, onions, etc., and sugar cane in the southwest. These are sold for local consumption in the interior districts.

6. Coastal plain of the southwest where sugar cane is almost exclusively planted.

7. Sierras on the south, devoted to coffee.



MAP OF THE DOMINICAN REPUBLIC, SHOWING THE PROVINCES



MAP SHOWING FOREST AND CROP DISTRIBUTION IN THE DOMINICAN REPUBLIC

PLANTS AND PLANT DISEASES

ALFAFA (*Medicago sativa L.*)

This forage plant has been known in Santo Domingo for a long time but has been only recently propagated chiefly in the areas under irrigation.

LEAF SPOT (*Cercospora medicaginis* E. & E.). Although quite common it is rather unimportant.

ROOT DISEASE (*Rhizoctonia violacea* Tul.). Frequent in plantations of the Cibao valley but rarely found in regions under irrigation. It does but little damage.

RUST (*Uromyces striatus* Schr.). Widely spread during certain periods of the year. During the rainy season, particularly, the attack of the rust is so serious as to practically spoil the first harvest, although with little damage to the second harvest.

AVOCADO (*Persea Persea* (L.) Cock.)

Widely cultivated throughout the country but only for local consumption.

ANTHRACNOSE (*Colletotrichum gloeosporioides* Penz.). While it is spread to a good extent, in the majority of cases, it is not very injurious.

GUMMOSIS (?) This disease is not widely distributed but is found in many plantations and is probably the most serious disease which affects the avocado. In spite of its slow progress and the fact that plants affected by the disease may live for several years, they eventually die. The disease presents the same characteristics as the gummosis of citrus plants. The removal of the diseased tissues and the application of iron sulphate gave favorable results in those cases where the disease was in an early stage, but not where the disease had reached an advanced stage. Nothing is known regarding the pathogenic agent.

LEAF SPOT (*Phyllosticta perseae* E. & M.) Rare and unimportant.

BANANA (*Musa paradisiaca* L., subsp. and var.)

Of extensive cultivation, especially the plantain. There are a number of varieties and the cultivation thereof is gradually being fostered for commercial ends. It is only during the past five or six years that bananas have been exported, which exports have been largely limited to the plantains. This plant which is not seriously attacked by insects, is severely affected by cryptogamous diseases, especially the Panama disease.

ANTHRACNOSE (*Colletotrichum gloeosporioides* Penz.) Widely spread and very injurious although its effects may be variable.

LEAF SPOT (different fungi). On dried leaves several fungi have been recognized, among which are: *Phyllosticta musae-sapienti* Frag. & Cif., *Leptothyrium musae* Cif. & Frag., *Macrophoma musae* (Cke) Berl. & Vogl., *Sphaeropsis paradisiaca* (Mont.) Sacc., *Sphaerella musae* Speg., *Cercospora* sp., etc., whose pathogenicity was not tested and therefore it is impossible to decide which of them are the real parasites. This disease is widely scattered but appears to do little damage.

PANAMA DISEASE (*Fusarium cubense* E. F. S.) This is the most serious banana disease in Santo Domingo. Its occurrence in 1925 was limited to a heavily infested center in La Vega and other centers of minor importance in Seybo, San Cristobal, San Juan de la Maguana, Moca, Santiago, Puerto Plata and Samaná. During the period of 1925 to 1929 the disease, in spite of the campaign of eradication practised, has spread all over the Republic and it is now difficult to find a banana estate which is not more or less affected by the disease. At the present time important centers of the disease are at Villa Vázquez, San Francisco de Macorís, Bonao, San Pedro de Macorís, Baní, Cabral, Bajabonico, etc., in addition to the afore mentioned districts. Although this disease causes serious damage, it is difficult to estimate definitely the extent of same. However, it has little bearing as a national problem since exports of plantains cover only the excess over local consumption. A duplicate series of trials made in La Vega and Moca by sterilizing the infected soil with mercury-organic products gave quite favorable results. However, this method can not be put in operation economically in the Dominican Republic on account of the low prices of bananas and also because of the large areas of virgin soils available at very low prices. Although we have made careful search we have been unable to find varieties immune to this disease. However, there are some resistant forms which are generally of little commercial value. The collection and study of the different varieties is still under way. Some varieties, commonly considered as immune, did not stand the test.

ROOT DISEASE (?) Quite frequent in plantings in wet soils of poor drainage and insufficiently aereated. The pathogenic agent is unknown; a *Marasmius* sp., which is at times present appears to be merely a saprophyte of little importance.

BEANS (*Phaseolus vulgaris* L.)

Among the annual crop plants with the exception of corn and tobacco, this is the most extensively cultivated plant in the Dominican Republic. Two types predominate, namely "Red Kidney" and "Pompadour", the former grown for exportation purposes is likely to surpass the latter. The damage caused to beans by cryptogamous diseases is unimportant as compared to the damage caused by insects, such as *Empoasca mali* Le Bar. This is at times well controlled by *Beauveria globulifera* (Speg.) Vuill.

ANTHRACNOSE (*Colletotrichum Lindemuthianum* (Br. & Cav.) Sacc. & Magn.) This is the most important of the bean diseases; the damage varies and may reach considerable proportions according to the stage of growth of the bean plant at time of attack.

LEAF SPOT (*Cercospora canescens* Ell. & Mart.) Of no economic interest.

POWDERY MILDEW (*Oidium erysiphoides* Fries). Very frequent but generally of no great importance.

PSEUDO MOSAIC (?) Widely spread. It appears to be in some way related to the attack of *Empoasca mali*.

ROOT ROT (*Rhizoctonia* sp.) This disease is generally of little economic interest, but may cause serious damage, especially in the provinces of La Vega and Espaillat, where during the rainy season it has totally destroyed plots of beans.

RUST (*Uromyces appendiculatus* (Pers.) Lév.) Common everywhere but of little economic importance.

CABBAGE, CAULIFLOWER, etc. (*Brassica* spp.)

Rarely cultivated, except throughout the neighborhood of towns and cities.

BACTERIOSIS (?) *Phytomonas campestre* (Pamm.) Comm.). Very common disease which under favorable conditions and when the plants are not properly cultivated may cause the death of 50 per cent (or even more) of the crop. The pathogenic agent was only identified by the etiological character of the disease.

LEAF SPOT (*Alternaria brassicae* (Berk) Sacc.) A very common disease which is quite harmful due to the fact that it impairs the quality of the product.

CACAO (*Theobroma* spp.)

For exportation purposes cacao is considered the second product in order of importance. Its range of cultivation covers practically the total area (about 90%) of the Cibao district in the provinces of Espaillat, La Vega and Duarte. The average annual production is almost constant and the extension of plantings is slowly decreasing, since this crop is gradually being substituted by coffee. The phytosanitary conditions of cacao, as a general rule, are poor. Although this plant is not affected in Santo Domingo by epidemics of severe nature, neglect in its culture usually results in serious losses. This is especially true if in addition to diseases of cryptogamic origin the plants also suffer from the attacks of the *Heliothrips rubrocinctus* Giard, rats and the bird, *Chryscrpes striatus* Mill. Consequently, the phytosanitary problem of cacao in the Dominican Republic is largely of an agricultural nature. If a systematic cultivation were followed and the plant received the proper technical attention, the damage caused by cryptogamous diseases and by the above referred to insect would be greatly ameliorated. It would avoid the expensive cost of the direct control of the diseases which at present leaves only a very narrow margin of profit to cacao growers.

In the Reports published by Descombes (**11**), he pointed out that he discovered in cacao plants along the coast of Samana Bay a *Stromatinia* (the illustration and description of which are identical with a *Monilia* sp.) as the possible cause of the death of the plants. The writer investigated the cacao estates of this region to ascertain a possible relationship to the *Monilia* of Ecuador (although the etiological characteristics were found at variance) and succeeded in discovering and isolating the fungus which was a true *Monilia* sp. The inoculation tests made by the author were always negative, the death of the plant being caused by the "root diseases" jointly with the attack of the *Heliothrips rubrocinctus,* the lack of shade and by the brown rot. The result of these experiments as well as a description of some leaf parasites was separately published by the author (**5**).

BLACK ROT (*Phytophthora Faberi* Maubl.). Although this disease is rather frequent it is not very injurious. Furthermore, a great variation is noticed in the plants in their resistance, not only in the various groups or varieties (the Calabacillo group presents the highest resistance, while the Criollo group is the most susceptible) but also in the individual plants, and we are of the opinion that through proper selection it might be possible to obtain resistant types of cacao.

BROWN ROT (*Diplodia theobromae* (Pat.) P. Henn.) Among the cacao diseases whose local effects have been reported, this is undoubtedly the disease which is largely responsible for the reduction of the crop, the most common type of the disease being the rot of the pod. The fungus develops and sporulates abundantly on the shells of ripe pods left over to rot on the soil after removal of the beans. The fungus lives in the old shells as a semi-saprophyte. We believe that this is the way in which the fungus maintains itself from year to year. Therefore, we have recommended the burying of the shells of all pods, both healthy and diseased and applying quick lime in the hole where they are buried. This simple practice has considerably decreased the percentage of infection in Barahona where the disease had been reported as serious.

CANKER (*Phytophthora Faberi* Maubl.). Quite frequent and somewhat injurious but not as serious as the root and pod rots.

CHLOROSIS (Various causes). This is a general symptom of disease which may be ascribed to various causes, lack of nutrition, canker, root diseases, etc. On several occasions we have observed that on soils which are calcareous-humic, or humic with calcareous sub-soil, plants usually become chlorotic and the root system is more or less injured. Experiments made by applying lime in the soil in which adult plants were growing will have caused a temporary chlorosis in the majority of cases (22 out of 26 treated), but within the course of from three to eleven months the symptoms disappeared.

DAMPING-OFF (*Phytophthora Faberi* Maubl.). This is said to destroy not less than one third of plants growing from seeds planted directly in the field. It is generally estimated that out of three seeds planted, one at least dies. The critical stage of the plant is when it grows to about eight inches; the leaves wilt rapidly and in the course of two, three or even eight or ten days they turn yellow and fall off. The lower portion of the stems shows a brown spot which rapidly spreads around and forms a ring; the bark is destroyed and the plant dies within a few days. This spot is likely to appear in any place on the hypocotyledonary axis. From the dead plants we succeeded in isolating a *Fusarium* sp. the inoculations with which gave negative results and a *Phytophthora* sp., probably related to *P. Faberi* Maubl., which when inoculated in sterilized soil, communicated the disease in 32 per cent of cases. The disease is more serious during the season of heavy rains and in soils which are extremely clayey, without drainage or with poor drainage.

DUSTY MOLD (*Actinomyces albus* Kr. emend. Waksm. & Curt. and *Actinomyces* spp.). While this is not really a disease since it represents the action of microorganisms which grow in the rind of the dry beans, this mold is still the object of investigations and a preliminary study of it has been published (4). The spores of the *Actinomyces* are carried from the shell of the pods to the beans chiefly by the hands of laborers. Further contamination takes place in the fermentation vats and in the drying sheds. The spores remain dormant while said processes take place, but it is chiefly during transportation in the hold of a ship where it is damp and warm, especially, that the spores germinate and the fungus becomes active. Cacao then takes a peculiar and disagreeable odor known as ''mold odor''.

SHEDDING AND OTHER ANORMALITIES OF FLOWERS (physiological causes). These diseases are harmful; however, it is desirable to investigate different cases. Abnormal proliferation of the flowers which are commonly sterile and known under the name ''male cacao'', is rather frequent; it is partially due to unknown physiological causes and is the most important of these diseases.

INTERNAL BLACK MOLD OF POD (*Aspergillus fumigatus* Fres.). Rather unimportant from a practical point of view, either because it is not a common disease or because it is almost exclusively confined to the small cacao estates in the San Cristóbal district along the southern coast of Santo Domingo. It is however, of great interest from a scientific point of view. The *Aspergillus fumigatus* makes its entrance through the shell and rapidly invades the whole fruit, preventing the pod from ripening, or injuring the beans in the case of ripe fruits. The exterior shows a diseased appearance only after the disease has reached an advanced stage and is detected easily by selecting the fruit. The inoculation experiments practiced verified the possibility of infection through the wounds, although with a limited percentage of positive results. There was no infection without injury or by floral contamination.

KNOT OR GALLS (?) Discovered only in Moca and San Francisco de Macorís. The woody galls may develop to the size of an egg, or even larger. They grow isolated in the branches and their bark is rough. They do not appear to be caused either by the *Sphaeropsis tumefaciens* Hedges or by the *Bacterium tumefaciens* E. F. S. Galls of a more or less hemispherical shape are easily detected on trunks attacked by a *Pseudococcus* sp. and there is a possibility that their occurrence may be in some way connected with the parasitism of this insect.

LEAF SPOT (*Phyllosticta theobromae* D'Alm. & S. da Cam.). A very common fungus, but of little economic importance. It attacks principally the scorched or old leaves or those attacked by the *Heliothrips rubrocinctus.* It is also found in a local form of little systematic value and together with three other fungi, which probably are of limited pathogenicity; (*Physalospora theobromicola* Frag. & Cif., *Septoria theobromicola* Cif. & Frag. and *Leptosphaeria theobromicola* Cif. & Frag.) (5).

PINK DISEASE (*Corticium ? salmonicolor* B. & Br.). Does not appear to be common, and is economically unimportant.

POD MUMMIFICATION (?) Very frequent; the nature of this disease is unknown. The young and tender pods turn dark, shrink and dry up in the course of a few days but remain attached to the stem of the plant. The disease is characterized by drying and mummification of the fruit; but there is no soft or wet rot. This peculiarity, in addition to the absence of the parasites above referred to (with a few exceptions of superposition), distinguish this disease from the brown rot and the black rot. This disease attacks only the very tender pods (of one or two inches, rarely of three inches in length), while the other two pod diseases attack the mature or ripe pods. We have been unable to discover parasites of a cryptogamic nature; the saprophytes which are common in the pods attacked by the other two diseases are very rarely present in this disease. We are of the opinion that the disease is of physiological origin and it is probably due to malnutrition of the plant which, consequently, is physically unable to ripen all the mature pods. A series of observations made on the number of mummified fruits on plants under different conditions of environment and age, and during several years, have confirmed our hypothesis.

RED RUST (*Cephaleuros virescens* Ktze.) Common everywhere but of no great importance, except when cacao leaves have been badly infested, which ususally takes place in plantations in poor growing condition. The same may apply to leaf lichens, bark lichens and mosses and other epiphytes found upon cacao.

"RONCET" (?) This disease which is very interesting from a scientific point of view, is economically unimportant. At least, for the time being, it spreads slowly and with difficulty. It is really infectious; so far, it has been found in a few cacao plantations in the province of Santiago toward Puerto Plata. It is of a doubtful nature and the development of the disease is so slow that it requires a number of years before it causes the death of the plant; normally this may occur in a period of two years, but sometimes a longer period is required. Some of the plants affected by the disease late in 1925, are still alive. This slow development renders it difficult to form a definite idea as to the symptoms and progress of the disease. The preliminary symptoms are therefore, unknown to us. When the disease reaches an advanced stage the most apparent symptom is a reduction in the number of leaves which are generally grouped together on the tips of branches. The leaves which at first may be normal in color and size, gradually shrivel in the spaces between the veins and as a general rule the corrugations are convex toward the upper surface of the leaves and concave in the lower surface. Frequently the leaves twist and bend. At the same time there is an irregular tooth-like appearance in the edges of the leaves. These assume various shapes and even more or less irregular notches are formed. Later an uneven discoloration may take place in the spaces between the veins and in fact a general chlorotic condition may be reached. The young sprouts likewise take an abnormal appearance; they grow very little and have very small leaves which never reach normal size. During the period of vegetative growth, comparatively long and thin twigs may be formed somewhat similar to those of ''witch's broom'' bearing here and there a few small leaves which never develop properly. (Plate I, Fig. 4). The twig dries and the vegetative reserve is confined to a few groups of leaves in the old branches. When the wrinkled leaves appear the plant has already stopped bearing. Although it may still produce flowers, these do not produce fruit or if they do, the young pod becomes mummified. However, the spread of the disease, as already mentioned, is very slow and irregular. The disease appears in neglected and poorly cultivated cacao plantations in which a few sporadic plants may be attacked by the disease. Growers report it as contagious but in a rather irregular manner; however this has not been verified by experiments. During three years we have kept a record of the number of plants attacked by the disease in a cacao plantation near Santiago and found five diseased plants in 1926; six diseased and two dead in 1927, and five diseased and four dead in 1928. The inoculation tests made by grafting diseased stems on healthy plants and by the inoculation of the juice obtained through maceration of diseased leaves, into the petioles and central veins of healthy leaves (adult and young) gave negative results. The numerous diseased twigs grafted to healthy stock did not develop, with the exception of one which died shortly afterwards and whose vegetative characters appeared to present the same symptoms as the twigs on diseased plants. (Plate I, Figures 1, 2, and 3 are illustrations of three stages of the disease.) In all probability this complex disease is of a degenerative type. It reminds us, *mutatis mutandis,* of the grape disease known in Europe as "roncet" or "cort-noué", whose nature is still unknown.

ROOT DISEASES (*Rosellinia* sp. and *Rhizoctonia* sp.). Among the cryptogamous diseases with general effects on cacao in Santo Domingo, the root diseases are probably the most destructive. While at first sight the symptoms appear uniform, it is possible to differentiate a large number of root diseases, the study of which is vast and complex. There are four types of root diseases affecting cacao in Santo Domingo. The first type, "Rosellinia root disease", which is the most widely spread and destructive is due to a *Rosellinia* sp. and probably caused by *R. pepo* Pat. The damage varies and may even cause the destruction of a large number of trees. Under environmental conditions favorable to the development of the disease it may spread rapidly, although sporadically. From an infested center of three diseased plants in a very neglected plantation sixty three trees died in the course of fourteen months. The alkalinity of the soil or sub-soil, which is altogether unfavorable to cacao, seems to be a predisposing factor.

A second type of root disease is supposed to be due to a *Rhizoctonia.* This may be the same as a disease reported from the British Antilles as due to *Sclerotium Rolfsii* Sacc. Inoculation of this fungus in soil of cacao seed beds gave a low percentage of infection (less than 2 per cent). A direct inoculation into young plants about three feet high caused the death of approximately 5 per cent of the plants. It is possible that conditions for infection were unfavorable. This disease is not as common as the "Rosellinia root disease" and that reported from the province of Duarte.

A third type of root disease may be designated "dry rot disease". The general characters are identical with the preceding, but the root does not present mycelium of the type *Dematophora* of the *Rosellinia* or the white mycelium and sclerotia of *Rhizoctonia.* Furthermore, a great majority of the rootlets die while the larger roots can long resist the disease whose course is slower than other root disseases, and does not appear as serious as these. The cause of the disease is unknown to us; however, a *Fusarium* sp. was isolated which we believe does not cause it. We are of the opinion that there is a close relation between the endotrophic mycorrhiza of cacao and this disease which usually appears in heavy soils, whether wet or not, but improperly cultivated and poorly aereated. A number of cases which appeared in San Francisco de Macorís were given a good pruning; the soil around the diseased plants was cultivated with the use of harrows, and these measures resulted in the recovery of most of the plants.

The fourth type known as "water root disease" appears in districts which are periodically flooded; or in low level places or basins without drainage in which case the rot of both the rootlets and roots takes place as far up as the stem of the tree; but there is no evidence of mycelium of parasitic fungi. This stage of the disease is the most characteristic. It does not have the nature of an epidemic and its spread is only effected under favorable conditions.

SAPROPHYTIC POD ROT (different fungi). It is important in cases of wounds made by the attack of the bird *Chryserpes striatus,* by rats and, occasionally, by fruit-eating bats. If the wound is made in pods which are about to ripen, the quality of the beans is poor. When they are mixed with other beans, they contribute to make the quality of the crop inferior.

SUN SCALD (physiological causes). In evidence in plants without shade or with deficient shade, but generally does not affect the young leaves, whose very slanting position might be considered as a heliophobic adaptation, also suitable to high precipitation. The disease is not serious. It is possible to discover, occasionally, the *Helminthosporium theobromicolum* Cif. & Frag., morphologically different from *H. theobromae* Turc., which does not appear to be parasitic, in addition to the three fungi which live with the *Phyllosticta theobromae.* Normally the damage caused by the *Heliothrips rubrocinctus* is attributed to this disease.

CASHEW-NUT (*Anacardium occidentale* L.)

While largely propagated, its cultivation is not the subject of industrial exploitation, and its commercial value is restricted to domestic needs.

ANTHRACNOSE (? *Colletotrichum gloeosporioides* Penz.). Not widely spread and although this fungus has been repeatedly found in the petiole, we are not sure that it is the real cause of the disease.

FRUIT FALL (physiological causes). It occurs sporadically and is of little importance. We might mention that artificial infections of *Thielaviopsis paradoxa* (De Seynes) v. Höhn. gave positive results.

CASSAVA (*Manihot manihot* (L.) Cock).

The cultivation of this product is on the same level with sweet potatoes, both as regards to extension and importance, as well as in regard to cryptogamous diseases. The *Dilophoneta ello* L., usually causes the greater damage.

ANTHRACNOSE (*Gloeosporium manihotis* P. Henn.) Very rare and unimportant.

LEAF SPOT (*Cercospora Henningsii* All.). Very common but of little interest because it ordinarily attacks adult or old leaves.

SOFT ROT (?) Similar to that of sweet potato but more frequent; it is quite important and causes serious losses in heavy soils.

CITRUS PLANTS (*Citrus* spp.)

Although citrus plants in Santo Domingo are extensively propagated, their cultivation is of little economic importance. This is also true of other fruit trees.

ANTHRACNOSE (*Colletotrichum gloeosporioides* Penz.). Does not appear to be very common. It attacks severely the young twigs, the buds, the leaves and sometimes the fruit.

BLACK ROT (*Alternaria* sp.) This disease is quite frequent, possibly more so than the fruit rot, but of little economic importance.

DODDER (*Cuscuta americana* L.) The attack of this parasite on citrus plants is extremely rare, in fact we have only once succeeded in finding it.

FOLIOCELLOSIS (?) Quite common but unimportant.

MISTLETOE (*Phthirusa* sp.) These parasites are not frequent and are of little importance.

FRUIT ROT (*Penicillium digitatum* (Pers.) Sacc.). Comparatively frequent; however of no great importance due to the fact that the fruits are disposed of immediately after the harvest.

GREASY SPOT (?) Not frequent and consequently of no interest.

GUM DISEASE (?) This is probably the most injurious disease. The most common form of gum disease discovered by the author is the foot rot. Wild orange trees appear to be more resistant to the foot rot than cultivated citrus trees.

MELANOSE (*Phomopsis citri* Fawc.) Uncommon and harmless.

PINK DISEASE (*Corticium ? salmonicolor* B. & B.). This disease exclusively attacks plants growing on coffee and cacao plantations which are exceedingly wet. It is serious.

PHOMOPSIS ROT (*Phomopsis* sp.) Less common than the preceding and more widely spread in the south than in the interior of the country.

Phyllosticta leaf spot (*Phyllosticta longispora* Mc Alp. and *P. aurantiicola* (B & C.) Sacc.) It is spread to a limited extent but is unimportant. The *Chaetophoma citri* Sacc. is frequently found in the same lesions.

Red rust (*Cephaleuros virescens* Ktze.) Very common on weak plants or on plants growing under excessive shade or in very wet places. Of as little interest as the leaf lichens.

Root diseases (*Rosellinia* sp.) Not a frequent disease, the cause of which was determined in but one instance.

Scab (*Sphaceloma Fawcettii* Jenk.) Very common; not less than 50 per cent of the cultivated plants are affected by this disease, which generally attacks sour oranges and grapefruits.

Septobasidiose (*Septobasidium lilacinum* Burt. and *S. spongia* (B. & C.). Pat.). Very widely spread; it attacks extensively the young twigs, the petioles and leaves, and even the fruit. It is associated with a coccid, but in itself is of little economic interest.

Sooty mold (*Capnodium citri* B. & C.) Widely spread and associated with different Coccidae, but of no importance.

Thrips injury. The author has discovered frequently associated with a *Thrips* sp. a mycelium of Dematiaceae, generally with no conidia, but occasionally with conidia of *Cladosporium* sp. similar to *C. citri* Br. & Farn. (different from *C. citri* Massee) which darkens the light spots produced by the Thrips.

Thread blight (*Corticum koleroga* (Cke.) v. Höhn.) This fungus is reported to attack citrus plants exclusively. The writer has discovered it on plants growing among coffee and cacao plantings which were attacked by this disease. It is of no importance.

Twig blight (? *Diplodia* sp.). The existence of this disease was not definitely ascertained, in spite of the fact that a *Diplodia* was discovered on several occasions on twigs affected by anthracnose.

Coconut (*Cocos nucifera* L.)

Although growing everywhere in the plains of Santo Domingo, its cultivation is not as important as it might be. It is cultivated in the south coast of the Peninsula of Samaná, and to some extent along the coasts of the Caribbean Sea and the Atlantic Ocean. The damages caused by cryptogamous diseases are doubtless of less intensity than that caused by the *Aspidiotus destructor* Sign., a serious enemy of this palm, and partly by the *Homaledra sabulella* Chamb.

BUD ROT (*Phytophthora palmivora* Butl.) A very rare disease which, although it has been occasionally discovered in different places has the tendency to be localized or to spread very slowly. It was reported in Cibao (Moca and Santiago), in Samaná and Monte Cristi, but was not found anywhere else. It was closely watched for in those places during the years 1925 and 1926 to ascertain the extent thereof. The two cases discovered in Monte Cristi were checked and there was no recurrence of the disease. On the contrary, in Moca and Santiago, where the cultivation of coconuts is of no importance, the disease appeared to spread very slowly. There were found in each province one case in 1925; in 1926 one case in Moca and two cases in Santiago. In 1927 two cases were discovered in La Vega which were not reported in 1928 and three in Santiago during 1927. In Samaná the number of palms affected is equally rare; five cases were identified in 1925 and seven in 1926. In the southern coast and Puerto Plata no cases have been reported to date. We are unable to explain the cause of the slow spread of this disease which ravages coconut plantations in the neighboring island of Cuba and is quite common in Porto Rico.

FRUIT DROP (?) This disease which makes its appearance at certain times, may be due to non-parasitic agents, although we have found a *Diplodia* sp., especially on the petiole. The falling of the young fruits is most abundant when they have reached a diameter of one or two inches.

LEAF BLIGHT (*Pestalozzia palmarum* Cke.) Common over all the Republic, but of no economic importance.

TRUNK ROT (?) Very rare and of unknown origin.

COFFEE (*Coffea arabica* L.)

Although the cultivation of coffee dates back to an early period, it is only during the last five or six years that it has increased considerably. There is no doubt that at the present time coffee is the crop which is being most rapidly extended in the Republic. It has become recently the third or fourth product in order of importance as far as exports are concerned, and it is expected that in the course of a few years it will be on a level with cacao and may even surpass the latter. The damages done by cryptogamous diseases of coffee are probably of minor importance as compared with the damage caused by insects, particularly the *Coccus viridis* Green and the *Leucoptera coffeella* Guér. Coffee is grown throughout the mountainous regions, but without uniformity.

We might mention that the leaves of young plants of *Coffea excelsa* Chev. have been attacked by the *Dyctyothyriella mucosa* (Syd.) Syd., but the disease has not been found on *Coffea arabica.*

BERRY ROT (?) A common disease, rarely injurious. The causes have not been determined although several fungi have been found on the berries. Before ripening, the berries show wounds or irregular lacerations and the fruits fall before they ripen fully. This disease is generally independent of the attack of *Cercospora coffeicola.*

LEAF ROT (*Pellicularia koleroga* Cooke). Not common and of no importance, except in coffee plantations in the vicinity of Bonao where the disease was widely spread and caused more damage than in other places.

LEAF SPOT (*Cercospora coffeicola* B. & C.). More important and more abundant than the eyespot although its behaviour varies according to the district and time. We have observed that it is more injurious in the provinces of Espaillat and Azua where it attacks both berries and leaves, while in other places it is the reverse. In general it can not be considered a destructive disease.

ROOT DISEASES (different causes). Among the cryptogamous diseases of coffee in Santo Domingo, this is the most serious, although the damage caused varies according to the place and time. As in the case with cacao there are various root diseases grouped under the same name which would seem to be due to different causes, even though the symptoms or effects on the plants may appear analogous or identical.

The first type is the "Rosellinia root disease" or "Black root disease" which appears to be the most harmful and widely spread. We have not determined the species of Rosellinia save in few cases where we have found it to be *R. pepo* Pat. The second type, not as frequent as the first, and found principally in Barahona is the "Rhizoctonia root disease" or "White root disease", whose characteristics are similar to the preceding, except for the presence of mycelial hyphae which are white instead of dark or black. Two different species, not identified, were isolated and inoculated in sterilized soil where there were young plants of from one to two years of age. The soil was black, humic and acid (pH 5.6). The percentage of infection was exceedingly low: less than one per cent. The experiment was again made on soil of pH 5.0 with practically the same result, i.e one per cent infection. A third experiment was made on calcareous clay soil, (pH 7.8) where the plants were transplanted. The percentage of dead plants was very high reaching

80 per cent and the majority showed the same symptoms observed in infected coffee plantations. Further tests, still unpublished, have proved that an acid soil is indispensable for the normal growth of coffee; a neutral soil is unfavorable and a small alkalinity is decidedly harmful. The plants vegetate slowly and with difficulty and show a more or less serious chlorosis. Under these conditions they are easily attacked by root diseases and especially the "dry root diseases."[*]

A series of further experiments on coffee plantations demonstrated that where root diseases were more severe and coffee vegetated with difficulty, bearing sparingly, and dying without any definite causes ("dry rot disease"), with a destruction of the young rootlets while there was no rot of the old roots; the hydrogen-ion concentration of the soil was greater than pH 6.6–6.8. Under such conditions the development of endotrophic mycorrhiza is great; as a general rule, it may be easily demonstrated by the Jause reaction. However, we have been unable to prove definitely that the *Rhizoctonia* which represents the root endophyte is the same one with pathogenic action, even though there are a number of indirect reasons for our assumption. The fluid of the liquid culture of the rhizoctonia-endophyte demonstrated, *in vitro*, a decisive pathogenic action on sections of young and healthy rootlets. A paper will be published later in connection with the root diseases of coffee and cacao.

Sooty mold (*Capnodium ? coffeae* Pat.). Associated with the attack of scale insects, especially *Coccus viride*. Of no importance although we have seen cases in which all the plant was covered with a thick black coating.

Eye-spot or "Viruela" (*Stilbella flavida* (Cke.) Lindau). Of no great importance, although wide-spread.

Corn (*Zea Mays* L.)

The production of corn in Santo Domingo which, until recently, was for the small local consumption has rapidly increased during the last few years and corn is now also grown for purposes of exportation. The so-called "Francés grande", which has been improved gradually is the type most widely propagated and cultivated. Corn is not seriously affected by cryptogamous diseases. Far more injurious to this crop are the Lepidopterous insects (*Laphigma frugiperda* S. & A. and *Heliothis obsoleta* Fabr.)

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[*] This is probably the same disease which in other countries has been doubtfully ascribed to Basidiomycetes.

RUSTS (*Puccinia purpurea* Cke. and *Uredo pallida* (Diet. & Holw.) Arth.). Of no great importance, although these two fungi are very common on mature and old leaves.

MOSAIC (?) Comparatively frequent, but causing no important damage.

SMUT (*Ustilago zeae* (Beckm.) Ung.) After a close search in corn plantations some cases of smut are almost invariably discovered, but this disease is of little importance. The damage due to this disease was less than ¼ of one per cent with the possible exception of some very occasional cases.

SPIKE TOP ROT (?) This disease is due to one or two species of bacteria. It develops only on young ears, which are not yet ripe, but which have been attacked by the larvae of *Heliothis obsoleta*. Subsequent to their attack it is possible that larvae of unidentified Diptera may develop, which in all probability, disseminate the bacteria. Even though we are unable to prove our assertion our opinion is based on our observation that this disease is constantly associated with the presence of larvae of Diptera and, consequently, associated with the attack of the *Heliothis obsoleta*. The end of the ear softens and rots, developing a yellow or dark color as the rot extends from the tip to the base. Normally the infection is confined to one inch but may spread practically all over the green ear, especially if it is still quite young. The affected part is unable to produce grains but the portion not affected ripens normally. Therefore, the damage caused by the disease varies greatly according to the intensity of the attack. If it is confined to the tip of the ear, as is usually the case, it is not important because the grains at the tip even under normal conditions, do not mature properly. In the other case the damage may be serious. At first we were of the opinion that the disease was caused by a saprophyte, since it was not transmitted by grafting small pieces of the ear, or by inoculating the tip of the healthy ears with an infected needle. However, having inoculated with bacteria by puncturing into the healthy culm of a series of corn plants, we have often obtained (11 out of 36 cases) the formation of a blackish necrotic zone which extends in a circle from the point of infection, and length-wise for about one half inch. The ears of the infected plants did not ripen and after a few days (7 to 15) the culm dried from the point of inoculation upwards. We have observed that a rainy season favors greatly the development of this bacteriosis which is seldom recognisable in dry weather, although the attack of the Heliothis may be serious. The early infection is more destructive than the late infection. The estimated average damage in experimental plots of the Station was about five per cent.

Cotton (*Gossypium* spp.)

Its cultivation which is almost exclusively confined to the province of Monte Cristi, is at present in a very neglected condition. This is due to the great damage caused by the *Pectinophora gossypiella* Saund., which is the most destructive pest of cotton in the Republic.

Angular leaf spot and bacterial wilt disease (*Erwinia malvaceara* (E. F. S.) Comm.). A very common disease and apparently rather serious.

Anthracnose (? *Diplodia gossypina* Ckc., ? *Colletotrichum gossypii* Southw.). Could really be considered as two different diseases but they have not been clearly differentiated in connection with the pathogenic agent and the etiology. Not very injurious.

Areolate leaf spot (*Ramularia areola* Atk.) As the preceding.

Internal boll disease (*Ashbya gossypii* (Ashby & Now.) Guill.) Found in Haina on buds of an spontaneous hybrid of *Gossypium hirsutum* x *G. barbadense*. Probably the disease may be more widely spread.

Mouldy boll disease (different species). This seems to be the most common of boll diseases and together with bacterial boll disease causes at least from five to ten per cent damage. The injury to bolls appears to be caused by different saprophytic fungi which have not been thoroughly investigated.

Rust (*Kuehneola gossypii* (Lag.) Arth.). Very common but rarely injurious.

Eggplant (*Solanum Melongena* L.)

The cultivation of this plant has more or less the same range as that of tomato. It is less affected by cryptogamous diseases than tomato and suffers more from the attack of insects.

Concentric fruit rot (*Phomopsis vexans* (Sacc. & Syd.) Hart.) It is the most harmful cryptogamous disease that attacks the eggplant. The degree of intensity varies considerably, and may cause the total destruction of the crop in times of high humidity. It is spread throughout Cibao. The attack on the leaves is of minor interest.

LATE BLIGHT (*Phytophthora infestans* (Mont.) de By.). This disease is seldom seen and is not clearly identified; it is of no economic interest.

LEAF MOLD (*Cladosporium fulvum* Cke.) Same as the preceding.

LEAF SPOT (*? Phyllosticta hortorum* Speg.) Apparently very common; it is injurious during the wet season but unimportant at other times. The pathogenic agent was not definitely identified.

SPOTTED FRUIT ROT (*Gloeosporium melongenae* E. &. H.). This parasite is frequenty associated with the fruit rot. It predominates in southern plantations rather than in Cibao where apparently it is less harmful.

GUAVA (*Psidium Guajava* L.)

This plant, generally speaking, is not cultivated except for a limited propagation of a number of sweet varieties. The commercial exploitation is confined to the wild varieties. The cryptogamous diseases are of no economic interest.

FRUIT ROT (*Glocosporium psidii* Del.) Very common but of little importance.

SILVER LEAF DISEASE (?) A very interesting disease from a scientific point of view which we have discovered only in Haina. The causes are unknown. The leaves of a diseased plant are generally of a silvery color. The plant does not bear, or bears sparingly, but ordinarily does not die.

LETTUCE (*Lactuca sativa* L.)

Very rarely cultivated.

DAMPING-OFF (*Pythium de Baryanum* Hesse). While it is quite common in seedbeds, it is not very harmful.

LEAF SPOT (*Cercospora longissima* Sacc.). Frequently attacks old leaves and therefore is unimportant.

LIMA BEAN (*Phaseolus lunatus* L.)

Grows throughout the country and is cultivated to a limited extent for local consumption.

ANTHRACNOSE (*Colletotrichum Lindemuthianum* (Sacc. & Magn.) Br. & Cav.) Rare and of no importance.

Root rot (*Rhizoctonia* sp.). Similar to the same disease affecting beans.

MAHOGANY TREE (*Swietenia mahogani* (L.) Jacq.)

This tree is widely distributed throughout the country. Although it predominates in the semi-arid regions of the south and northwest, where it appears to be gradually losing ground and in certain places has entirely disappeared. A survey was made for the purpose of ascertaining the causes for the decline of this tree but it has not been published.

LEAF SPOT (*Pestalozzia swieteniae* Cif. & Frag.) This disease was found only in seed beds of the Agricultural Station in Haina. It is not very serious.

MISTLETOE (*Phoradendron Haitiense* Urb.) * Very common but apparently does little harm.

MELIOLA LEAF SPOT (*Meliola swieteniae* Cif., n. sp. ad. int.) Found in southern coast, apparently rare and unimportant.

MALANGA, TARO, etc. (*Caladium* sp.; *Xanthosoma* sp.)

These plants grow extensively but are rarely cultivated, and are of no commercial importance.

INTERNAL ROT (?) A sporadic disease which at certain times and places causes serious damages in plantations. The characters of the disease correspond to the so-called "mal de la malanga" (taro wilt) in Porto Rico and probably to the disease which in Jamaica is ascribed to the *Vasculomyces xanthosomae* Ashby, but we have had no occasion to investigate it thoroughly.

Its presence was reported sporadical and serious in the provinces of Duarte, Puerto Plata and Espaillat.

LEAF SPOT (?) Very common but unimportant.

SOFT ROT (*Erwinia carotovora* (Jones) Comm.). The rot of the rhizome of this plant was induced and it was experimentally reproduced on *Alocasia macrorrhiza*, *Colocasia antiquorum*, *Caladium Schomburghii* var. *pictum*, *Iris germanica*, *Daucus carota*, *Hyacinthus orientalis*, *Lycopersicum esculentum*, *Zantedeschia aethipica* and *Gladiolus hybridus* (5).

MANGO (*Mangifera indica* L.)

This tree ranks with the avocado in importance but it is more widely propagated.

ANTHRACNOSE (*Colletotrichum gloeosporioides* Penz.) It is the most serious disease of the mango and causes the loss of a considerable amount of fruit, especially if the attack of the disease is severe before the fruit ripens. It is less injurious to leaves.

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* Reported by Dr. E. E. Ekman.

FRUIT ROT (*Diplodia mangiferae* Koord.) A rot of the fruit which is less common than the anthracnose, with which it may be associated. The fungus lives on the leaves with difficulty. It is probably the same species previously designated *Lasiodiplodia* sp., *Lasiodiplodia theobromae* (Pat.) Griff. & Maubl. and *L. tubericola* E. & E. Apparently it is not wide-spread or very harmful. During the summer of 1929 there was reported in Samaná, near Sabana del Mar, the attack of a *Phytophthora* sp. which destroyed about 50 per cent of the crop. The fruit was affected before ripening. This disease which is still the subject of study and investigation has not since been rediscovered and we might mention that it had not been reported prior to 1929.

MANGOSTEEN (*Garcinia mangostana* L.)

Recently introduced and its cultivation is confined to a few plants.

ANTHRACNOSE (*Gloeosporium mangostanae* Cif.). Different from the *Gloeosporium garcinia* Koord. It is in all probably a leaf parasite. It is so rare that it has been impossible to determine its true nature. Like the former, this fungus does not affect the *Garcinia tinctoria* (DC) Dawn. (**5**).

LEAF SPOT (*Pestalozzia Espaillati* Cif. & Frag.) It is frequently found on the apex of dry leaves. Inoculation experiments gave negative results (**5**), both in tests with *Pestalozzia clusiae* Griff. & Maubl., which lives on leaves of *Clusia rosea*, of the same family and which we presume is adaptable to the mangosteen, and the *Pestalozzia canangae* Koord. of the "Ylang-Ylang". This species is probably a secondary parasite which lives upon leaves of plants affected by the root disease. The *Pestalozzia Espaillati*, common upon *Garcinia mangostana* was never found to attack *Garcinia tinctoria*.

ROOT DISEASE (?) The most common and harmful disease which destroys over 90 per cent of young plants in seedbeds; the cause of the disease is unknown to us.

MULBERRY (*Morus* spp.)

Although this tree formerly existed in the island, its propagation dates from the last three or four years, in connection with the possibility of fostering the silk-worm industry.

BACTERIOSE (*Phytomonas mori* (Boy. et Lamb.) Comm.) This disease has not been definitely identified and has been found only in Moca.

OKRA (*Abelmoschus esculentus* (L.) Moench.)

Common throughout the country but rarely cultivated.

FRUIT ROT (?) A common disease which is quite serious during rainy seasons.

LEAF SPOT (*Cercospora hibisci* Tr. & Earle.) Quite common, but causing little damage.

ONION (*Allium Cepa* L.)

The systematic cultivation of this plant for commercial needs is of recent date and prevails in the irrigation districts, but it is grown throughout the country on a small scale. In addition to some serious cryptogamous diseases, it is also attacked by a serious pest, the *Thrips tabaci* Lind. The latter is an important factor in the reduction of the crop which can thus be obtained only at a certain time of the year.

BACTERIAL ROT (*Erwinia carotovora* (Jones) Comm.) It is found only in the clay soils of Cibao during the rainy season and is very severe. This disease was not discovered in Santiago, Monte Cristi and San Juan de la Maguana.

LEAF SPOT (*Alternaria porri* (Ell.) Cif.) This is the most serious cryptogamous disease that attacks onions in Santo Domingo. Its damage shows great variability, and the general average may be estimated at not less than 10 per cent and very often higher. The preventive measures for this disease have been thoroughly investigated, and the use of the mercury-organic compounds or Bordeaux mixture have been most effective if applied freely as a prophylactic. As a matter of fact, the most serious attacks result from the time of the transplanting of the young plants to the time when the plants have grown approximately five or six inches. The control of the disease is of minor importance due to the fact that late infections are not serious. The systematic position of the fungus which causes the disease was the object of investigation which proved rather complicated. We have excluded the *Macrosporium parasiticum* Thuem., which was frequently present because the inoculation tests were always negative. The disease has been reproduced both by *Alternaria alli* Nolla and by *Macrosporium porri* Ell. The disease is hardly recognisable. The same may be said regarding its morphological, biometric and cultural characters in the cultures with the exception of mutation and aberrant. forms. Therefore the two species appear to be identical and if we admit the validity of the genus *Macrosporium* with the denomination of Nolla, the fungus should then be known as *Alternaria porri* (Ell.) Cif.

PAPAW (*Carica papaya* L.)

It is widely propagated, but its cultivation on a small scale is of no economic importance.

CURLY LEAF (?) This disease is largely spread throughout Cibao, chiefly in the interior as far as the Province of Samaná where it was first discovered. Its characteristics are very evident, but the causes thereof and its etiology are still uncertain. The disease generally affects old plants even though it may occasionally attack young plants. The first visible symptom is a curling of the younger leaves which gradually twist to form "cushions". At the same time the old leaves take a partial yellowish color forming a mosaic of yellow and green spots. The old leaves are partly curled and the leaf blade presents gradations which closely resemble analogous formations in tobacco mosaic. In the course of one or two months all leaves either young or old, fall off after turning entirely yellow or they dry up and the petiole bends but the leaves do not fall. The plant rarely bears during this period and if it does, it is unable to develop the fruit to maturity. When the plant loses its leaves, new growths are developed generally apically, frequently they are lateral growths but they never appear in multiple formation. Sooner or later they assume the diseased appearance previously described and on falling, are replaced by similar new growths. This condition may prevail for a number of months (or even for a year or two) when the plant finally dies; it is very seldom that the plant succumbs to the first attack. In a number of cases, but not invariably, the trunk shows a series of epidermal suberous growths which appear irregularly and lengthwise, generally in the top-most part. These suberizations are formed by stratified layers of cork, slightly sub-epidermal, which are not found on healthy plants and whose presence we were unable to understand. A number of researches on the latex of the papaw tree in different places and at various times gave negative results with the exception of bacterial zoogloeae which was found once. We have never succeeded in discovering protozoa.[1] A further series of inoculation experiments using latex of diseased plants gave different results; in one instance most of the plants inoculated were infected (18 out of 20); in other cases the percentage was smaller (3 out of 9 plants; 5 out of 14; 2 out of 17 and 1 out of 18). Possibly this is the same as the disease reported on this plant in Jamaica.

FRUIT FALL (*Thielaviopsis paradoxa* (Seyn.) v. Höhn.). This disease is quite common during the winter and spring, but is of no economic interest. Artificial infections developed the disease on this plant as well as on *Curcubita moschata* and *Anacardium occidentale* (5).

FRUIT ROT (*Rhizoctonia papayae* Cif.). A common disease of destructive character during heavy rains, but not at other times. While it may affect all the fruits on a plant, it generally attacks those growing near the ground. The fungus lives in the soil, preferably in the surface, among rotted leaves, etc. and gradually moves upward to the fruit. It can make its entrance only through a wound, such as those incisions made on the fruit to drain out the latex before the fruit ripens or by any other mechanical injury. The disease has been reproduced artificially only through wounds. Where the fungus makes its entrance a depression is formed which becomes soft and of a dark yellowish tinge. The mycelial hypha rapidly ramifies invading all the mesocarp until it reaches the interior cavity where a white coat is formed over the seeds and checks their growth. The fruit turns yellow as if it were ripening, but it actually rots and softens through the action of this fungus or other micro-organisms. It finally falls to the ground. The fungus does not form sclerotia in culture, but only in the interior of the fruit in the intercellular spaces of the mesocarp. This disease may be checked or its damage reduced by frequent cultivations of the soil and by avoiding the planting of dwarf varieties or varieties which bear low. It has been demonstrated that the fungus lives in the soil. A more complete paper on this subject is in the course of preparation.

LEAF SPOT (*Pucciniopsis caricae* (Speg.) Earle). Very common but rarely injurious.

PEA (*Pisum sativum* L.)

Very rarely cultivated.

LEAF SPOT (*Cercospora pisi-sativae* Stev.). Not abundant.

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[1] In Moca, in the latex of the *Asclepias curassavica* a flagellate was once discovered apparently very similar to the *Leptomonas Elmassiani* Mig., and this same species or one of great affinity was once found in the latex of *Calotropis procera*, in a plant in the neighborhood of Baní.

POWDERY MILDEW (*Oidium erysiphoides* Fr.) Of little importance.

PEANUT (*Arachis hypogaea* L.)

This plant is extensively cultivated in Santo Domingo, especially in the regions of Villa Vázquez, Santiago and in the southern part (San Juan de la Maguana). In spite of this, the exports are very limited. This plant is affected by a number of insects and diseases, often associated, and both of which are injurious.

LEAF SPOT (*Cercospora personata* E.). Very frequent, but causing serious damage only occasionally.

ROOT DISEASES (*Rhizoctonia* sp.). The most serious disease which may cause a considerable reduction of the crop during periods of heavy rains, especially in Cibao.

RUSTS (*Uredo arachidis* Lagh.). Very common but as a rule not injurious except in the case of young plants.

PEPPER (*Capsicum annum* L.)

This crop is grown throughout the country, but less abundantly than any other solanaceous crop.

LEAF SPOT (*Cercospora capsici* Heald & Wolf.). Quite common but of little economic interest.

MOSAIC (?) Not very common and consequently unimportant.

ROOT ROT (? *Rhizoctonia* sp.). Rare in the Cibao and of no importance.

SPOTTED FRUIT ROT (*Gloeosporium piperatum* E. & E.). This disease is less widely spread than the zonate fruit rot with which it is at times associated and is of little economic importance.

ZONATE FRUIT ROT (*Colletotrichum nigrum* E. & H.). The most common and injurious disease, which under favorable growing conditions (wet weather) may destroy 75 per cent of the crop.

PINE (*Pinus occidentalis* Sw.)

This tree is widely distributed wherever ways of communication permit it and covers a vast area, especially in the Central Cordillera (see map on page 9). We have not discovered any diseases on pine worth mentioning and, as far as can be ascertained, it is not affected by rusts.

PINEAPPLE (*Ananas Ananas* (L.) Cock.)

This plant grows throughout the Republic but is most intensively cultivated along the Cibao district, chiefly in La Vega, where exquisite fruit of a very sweet and fragrant variety, locally known as "pan de azúcar" (sugar-loaf pineapple) is produced. However, its cultivation has not been industrialized although there is a tendency towards a greater development. Cryptogamous diseases cause appreciable damage to the crop.

FRUIT BACTERIAL BROWN-ROT (*Erwinia ananassae* Serr.) This disease the cause of which we have not been able to isolate, but which appears to be identical with the disease reported from the Philippines and Haití, is quite familiar although it varies considerably. The pineapple denominated "francesa" (Smooth Cayenne ?) is apparently affected by diseases as severely as the native sugar-loaf pineaple. The disease is most common in the Cibao region.

BASE ROT (*Thielaviopsis paradoxa* (De Seyn.) *v.* Höhn.). This disease is spread all over the country but is especially serious in the districts of Espaillat, Duarte, La Vega and Samaná where during the rainy season the crop is considerably reduced.

BROWN LEAVES, CHLOROSIS, TANGLE FOOT, etc. (Different causes). We have grouped together a number of diseases, the causes thereof being difficult to identify. They are largely due to parasitic agents, or at least primarily so, even though organisms of secondary importance may follow. These diseases may be due to manifold causes; lack or excess of water, comparatively high lime content of soil, excessive clayey soil, inadequate preparation of soil, lack of the necessary assimilative nutritive elements in soil, etc. This group of diseases is often found in pineapple plantations and prevents a profitable cultivation of the fruit in certain localities.

ROOT DISEASES (?) This disease is frequent and quite harmful in the clay soils of Cibao during the rainy seasons. It is frequently associated with the base rot.

POTATO (*Solanum tuberosum* L.)

The cultivation of this solanaceous crop has been considerably intensified during the last few years, chiefly in the northern and southern districts under irrigation. The output in these districts supply the local market with a good portion for domestic consumption.

DRY ROT (*Fusarium solani* (Mart.) Sacc.). This is the most widely spread disease of the potato, however, it is not very serious.

LATE BLIGHT (*Phytophthora infestans* (Mont.) de Bary). Probably the most serious disease of the potato, especially in the Cibao district and in the South. The mean annual loss may be estimated at not less than 15 per cent; in some cases it may reach 80 per cent. It is less frequent in the tubers.

LEAF SPOT (*Septoria lycopersici* Speg.). Of little economic importance although wide-spread.

SCAB (*Actinomyces scabies* (Thaxt.) Guss.) A common and harmful disease which, however, is confined to certain places in the district under irrigation in Villa Vázquez and in the north where it may cause an appreciable reduction of the crop.

TIP BURN (physiological causes). Quite common, chiefly in the irrigated districts of the north and south, but it is of no special economic interest.

WET ROT. (?) It occurs frequently in stock kept in warehouses and affects both the quantity and the quality of the crop. It is caused by one or more species of bacteria not identified.

SESAME (*Sesamum orientale* L.)

Rarely cultivated in the interior of the country.

BLACK SHANK (*Phytophthora* sp.). This disease assumed a destructive character in Villa Vázquez, in irrigated places and in Santiago, only during 1928. Apparently it presents the same characteristics as a similar disease on tobacco. In the course of a few days, usually a week, the plant dies, the leaves dry, the stem becomes black and the disease, even post-morten, spreads from the lower portion of the stem, upward. In infected material in a damp chamber we have observed the rapid growth of a Phytophthora, not found in all the specimens. This fungus has been held responsible for the disease. The fungus is frequently associated with a *Fusarium* sp., as in the case of tobacco, which has a disease very similar to this one. Wherever the fungus developed in 1928 it totally exterminated the sesame plots, but we have not discovered this disease in other parts of the country.

LEAF SPOT (*Cercospora sesami* Zimm.). Very common everywhere, but of no economic importance.

ROOT ROT (*Rhizoctonia* sp.). Occurs rarely in the clay soils in Cibao during rainy seasons.

SQUASH (*Pepo* sp.)

Widely cultivated but only for local consumption.

DOWNY MILDEW (*Pseudoperonospora cubensis* B. & C.). It is a common but unimportant disease.

PINEAPPLE DISEASE (*Thielaviopsis paradoxa* (De Seyn.) v. Höhn.). This disease did not appear spontaneously but was artificially caused by inoculating this fungus into the young fruit with cultures of fungus isolated from papaw (5).

STAR APPLE (*Chrysophyllum Caimito* L.)

Common but rarely cultivated.

ROOT ROT (?). Of the very few parasites of this tree, this is the only one of any interest.

SUGAR CANE (*Saccharum officinarum* L.)

This plant, extensively cultivated throughout the southeastern part of the Republic, and to a more limited extent in the southwest and north, is the most important crop of the Island. The phytosanitary conditions, have been improved in recent years but are not good and the yield of sugar is generally low.

LEAF SPOTS (*Helminthosporium ocellum* Faris; *H. stenospilum* Drechsler; *Cercospora sacchari* v. Breda de Haan). While these three fungi are widely distributed they can not be regarded as causing appreciable damage in cane varieties that are extensively cultivated.

LEAF VARIEGATION (?). Apparently this disease is not of an infectious nature. We have found it only on Cristalina and Japanese canes and so far as can be ascertained it does not cause serious losses.

MOSAIC (?). This is undoubtedly the most serious sugar cane disease, all others being comparatively unimportant. Plantations were originally planted to "Caña-blanca" or "Cristalina" and allowed to run for ten or even twenty years; the cane being cut every year. With the spread of the mosaic, care was not taken to plant seed of healthy cane, or to eliminate the diseased young plants or to substitute rapidly the old varieties by resistant or immune varieties. Consequently a general low yield followed and this depression was aggravated by low sugar prices since 1925. After a number of experiments, some of which were unsuccessful, the old canes have been substituted by new varieties, particularly during 1927 and 1928. At the present time the POJ–varieties, especially POJ–2725, are the most popular. The POJ–2878, recently introduced, is being extensively propagated and the POJ–2883 will shortly follow. However, the substitution in plantations where there is a high percentage of disease is not proceeding as rapidly as is desired, chiefly due to the economic crisis of the sugar industry. There are still a large number of fields which should be replanted with new varieties. Fields with 100 per cent infection are of very common occurrence.

PINEAPPLE DISEASE (*Thielaviopsis paradoxa* (De Seyn.) v. Höhn.). An uncommon disease which we have observed only twice. It is of no economic importance.

POKKAH-BOENG (*Fusarium* sp.). This disease, so far, has been discovered only on POJ–2714, POJ–2725, and POJ–2878, but does not cause serious damage. The last mentioned variety appears to suffer most. It is possible that the slight damage is due to the comparatively limited propagation of this variety. The cases reported on Cristalina should be referred, in our opinion, to the twisted-top and not to the "pokkah-boeng."

RED ROT (*Colletotrichum falcatum* Went). In relation to the damage caused, this disease is second only to mosaic. It is difficult to give any definite figures regarding the extent of the damage which varies greatly from year to year. This fungus may also present a form of Hyphales Tuberculariaceae (5).

RED ROT OF LEAF SHEATH (*Sclerotium Rolfsii* Sacc.). Wide-spread but of no economic importance.

RED SPOT OF LEAF SHEATH (*Cercospora vaginae* Krüger). About the same as the preceding.

RIND DISEASE (? *Pleocyta sacchari* (Mass.) Petr. & Syd.). This disease, whose existence as a separate entity is doubtful, does not cause appreciable damage.

ROOT DISEASES (*Rhizoctonia* sp. with other fungi, not determined). They are less serious than the preceding, but very common. A careful investigation on the percentage and general damage did not give positive results. A study made by the author showed this disease to be related to the mycorrhizic infection and the pathogenic agents are some species of Rhizoctonia and a Phycomycete, not identified, probably different from a *Pyythium* sp. common on diseased roots (7).

We might mention that so far we have not been able to find the "gum disease", or the "dry top rot" in Santo Domingo.

SWEET POTATO (*Ipomoea batatas* (L). Lam.)

A large number of varieties are extensively cultivated in Santo Domingo, the total production being used for local consumption. The damage done by diseases is limited and the plant suffers more from the attack of the *Cylas formicarius* Fabr. and various other insects.

BLACK ROT (*Sphaeronema fimbriatum* (E. & H.) Sacc.). The most common and injurious disease affecting sweet potato.

JAVA BLACK ROT (*Diplodia* (*Lasiodiplodia*) *tubericola* E. & E.). Common and quite severe, varying according to the season and place.

LEAF SPOT (*Cercospora bataticola* Cif. & Brun. ad. int.). Rare and of no economic importance. This species is quite different from *C. batatas* Zimm.

RUST (*Coleosporium ipomoeae* (Schw.) Burr.). Very common but of no interest from the economic point of view.

SOFT ROT (?). A common disease which may affect sweet potatoes both stored and under the ground. It may be the most important disease in plantations poorly cultivated and is probably due to several different causes.

SCLEROTIAL BLIGHT (*Sclerotium Rolfsii* Sacc. and ? *Rhizoctonia* sp.). Uncommon and harmless.

MOLDS OR SOFT ROT (*Rhizopus* sp. and allies). A very common disease which occurs on stored potatoes and is more or less serious.

WHITE RUST (*Albugo minor* (Speg.) Cif.) Very common but without any economic importance. The author (6) found a biological specialization of the *Albugo* on this plant in connection with the same fungus living upon other Convolvulaceae on the basis of cross inoculations and biometric criteria, thus accepting the Spegazzinian name and elevating the variety of this author to the rank of a species.

TOBACCO (*Nicotiana tabacum* L.)

Among the crops of secondary importance, this is one of the first. The value of tobacco exports, however, is subject to considerable fluctuations. It is mostly cultivated in Santiago and in other provinces of the Cibao Valley, but to some extent, throughout the Republic. The adult plants suffer severely from the attacks of insects, chiefly the *Protoparce sexta.* The most popular variety is the one denominated "Criollo" a hardy and resistant veriety but of poor quality, especially the low, unselected grade. The cultivation of the "Habana" variety and of other varieties of good quality such as a hybrid of "Sumatra", etc. is quite limited.

BLACK SHANK (*Phytophthora nicotianae* van Breda de Haan). A very rare disease which normally is of no economic importance probably due to the comparatively high resistance of the "Criollo" variety generally cultivated. On the contrary we have observed it to assume a destructive character on foreign varieties of recent importation and cultivated for experimental purposes, such as a series of varieties of the oriental type, a "Virginia" variety and one known as "Egipcia".

DAMPING-OFF (*Pythium de Baryanum* Hesse and *Rhizoctonia* sp.). This is the principal and most harmful tobacco disease even though the loss in seed beds is not great. The practice of making seedbeds without previously sterilizing the soil or in inadequate plots, and during rainy seasons, favórs the development of this disease. The principal agent appears to be *Pythium de Baryanum*, even though at times it is partly due to one or more species of Rhizoctonia. The writer made a number of experiments for the purpose of developing an economical and efficient prophylactic treatment, and after numerous tests, it is recommended to use the mercury-organic compounds.

LEAF SPOTS (*Cercospora nicotianae* E. & E.). Very common but of no economic importance. The same may be said of the *Phyllosticta hainensis* Frag. & Cif., an endemic species which is confined to the southern coast and the *Sphaerulina hainensis* Frag. & Cif., which is probably a semiparasite and occurs in the spots of the *Cercospora nicotianae*, also restricted to the same region and very uncommon.

MOSAIC (?). Scattered widely and irregularly in tobacco fields. The most serious forms are less frequent. The disease appears to be quite injurious in spite of which it is overlooked by growers.

ROOT DISEASE (*Rhizoctonia* sp.). Not frequent and apparently confined to the tobacco fields in humic clay soils, especially in the northeastern part of the Cibao Valley. Does not cause great injury.

WILT (*Erwinia solanaceara* (E. F. S.) Comm.). A very exceptional disease; even the very few cases reported appear doubtful in that the microorganism which produces the bacteriosis was not studied in pure culture and the disease was only identified by its etiological characters. If the disease actually exists, there is no doubt that the "criollo" tobacco is highly resistant to it.

TOMATO (*Lycopersicum lycopersicum* (L.) Karst.)

This plants grows throughout the country but its cultivation is quite limited.

ANTHRACNOSE (? *Phoma destructiva* Plowr.). One of the most familiar tomato diseases which may reduce the crop in certain plots to about 50 per cent. The parasitic agent was not definitely identified and appears sporadically.

BACTERIOSE (*Erwinia carotovora* (Jones) Holl.). This disease which affects the young fruit does not arise naturally and was only artificially produced by inoculations.

CRACKS (?) Apparently they are not of parasitic origin and they are of no economic importance.

DAMPING-OFF (? *Pythium* sp.). Very frequent in seed beds and while the percentage of dead plants is high, it is of no great importance.

MOSAIC (?) Very common; however it is rather harmless.

NAILHEAD RUST (*Alternaria solani* (E. & M.) J. &. S.). Very common but not important.

FUSARIUM WILT (*Fusarium lycopersici* Sacc.). Less frequent and serious than the preceding; it is found principally in the regions under irrigation in the northwest and southwest.

LATE BLIGHT (*Phytophthora infestans* (Mont.) De Bary). Very common at certain times of the year. It is undoubtedly the most injurious of the tomato diseases and may destroy all the plants in a plot.

LEAF MOULD (*Cladosporium fulvum* Cke.). This fungus usually attacks the leaves and is rarely injurious, except when it affects the fruit.

LEAF SPOT (*Septoria lycopersici* Speg.). Usually of no economic interest.

ROOT ROT (*Rhizoctonia* sp.). Apparently uncommon and confined to the Cibao district; it is of little importance.

In addition to the above, mention should be made of a tomato rot disease in which we have repeatedly discovered the *Cephalosporium acremonium* Corda. Inoculation experiments made on healthy fruit, ripe or green, by spraying a suspension of conidia, gave negative results. It has been observed that during rainy weather a very small wound is sufficient for the fungus to invade the ripe fruit rapidly and cause it to rot. This disease shows a great similarity to the *Oospora* rot reported as serious in Florida.

TONKA BEAN (*Coumarouna punctata* Blake).

This plant has recently been introduced from Venezuela. The success obtained from the first planting has resulted in the extension of plantings which are increasing rapidly, consistent with the good characteristics of the tonka as a crop plant.

LEAF SPOT (*Phyllosticta diptericicola* Frag. & Cif. and other fungi). The *Phyllosticta diptericicola* is usually associated with the root disease, of which it is generally an exterior symptom; however, it may also affect leaves of plants whose root systems are healthy. Associated or separately the following fungi may be found; *Melanochlamys coumarounae* Frag. & Cif.; *Didymosphaeria coumarounae* Frag. & Cif.; *Leptosphaeria coumarounae* Frag. & Cif., etc., which are in all probability of secondary importance.

ROOT DISEASE (?). The most wide-spread and harmful disease. The causes are unknown to us. The young plants up to the third year are more susceptible to the disease than the adults. The percentage of dead plants may be estimated at not less than 50.

YAM (*Dioscorea* spp.)

Rarely cultivated although growing throughout the country.

LEAF SPOT (*Cercospora carbonacea* Mill.) Discovered several times in Moca as the cause of some damage. Although a few species and varieties of *Dioscorea* were growing together *D. alata* L. was the only one affected by the disease.

ZAPOTE (*Calocarpum mammosum* (L.) Pierre)

Rarely propagated and of local interest.

FRUIT ROT (?) Due to an undetermined cause, but possibly, or at least in some cases, it is due to *Colletotrichum gloeosporioides* Penz., which we have discovered on more than one occasion. The disease is frequent and causes a large percentage of fruit loss.

SUMMARY

This comprises a list of the most important diseases from the economic point of view, which affect cultivated plants in Santo Domingo, with brief notes on their importance and distribution, as well as the most widely distributed diseases of little economic importance and also those of marked scientific interest. In a very general way, mention is also made of a number of experiments that were made, some of which have been reported and others are in the course of publication. We also touch briefly on different diseases which are new or almost unknown.

Following a short introduction aiming to enumerate the previous phytopathological and mycological surveys and a brief statement regarding the agricultural production of Santo Domingo and the different agricultural zones of the Republic, we discuss 53 cultivated plants, affected by 175 diseases of which 122 are presumably or definitely ascribed to fungi, 33 to non-parasitic causes, virus or unknown causes, 13 to Schizomycetes, 3 to Algae, and 3 to parasitic Phanerogams. The total number of fungi reported totals 151, in addition to which 13 insects are cited among those of greater interest.

A more complete study is made of the principal plants of the Republic from the economic standpoint namely sugar cane, cacao and coffee.

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NATIONAL AGRONOMIC STATION AND COLLEGE OF AGRICULTURE.
MOCA, DOMINICAN REPUBLIC.

EXPLANATION OF PLATES

PLATE NO. I

Fig. 1.—Twig and leaves of a cacao plant affected by "roncet", showing the alterations on the lamina and the foliar limbus.

Fig. 2.—Same as above, but the alterations prevail in the foliar limbus.

Fig. 3.—Appearance of two papaw plants affected by the "curly top"; (figures at the center and to the right); the figure to the left shows a healthy plant. Note the fallen leaves and the new growths,—apical and basal.

Fig. 4.—Twig of cacao affected by the "roncet", resembling the "witch's broom". Note the exceptionally long stems with small leaves, poorly shaped.

PLATE NO. II

Fig. 5.—The upper figure shows a papaw plant affected by the "curly top". Note the lateral leaves partly fallen and the formation of the rosette of leaves.

Fig. 6.—Young rosette with small leaves densely clustered; the stem is all covered with corky layers.

Fig. 7.—Part of a stem showing layers of cork.

Fig. 8.—Leaves intensely curled but showing little or no discolorations of mosaic nature.

Fig. 9.—An old leaf, curled and with discoloration of mosaic character.

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PLATE I

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PLATE II

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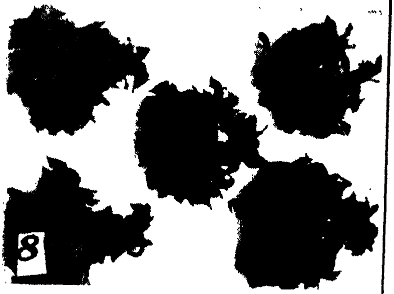
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MELVILLE T. COOK, Editor.

A New Mechanical Method for Artificially Transmitting Sugar-Cane Mosaic

By
FRANCISCO SEIN, JR.

The Effect of Some Mosaic Diseases on Cell Structure and on the Chloroplasts

By
MELVILLE T. COOK

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A NEW MECHANICAL METHOD FOR ARTIFICIALLY TRANSMITTING SUGAR-CANE MOSAIC

By FRANCISCO SEÍN, JR.

The study of sugar-cane mosaic transmission and its insect vectors started at the Insular Experiment Station in 1918 by Smyth and carried on by Wolcott and Chardon has been continued by the author since 1922 up to the present date.

For the purpose of obtaining data on how the virus of sugar-cane mosaic is introduced by the insect vector into the tissues of the healthy plant, a new method of artificial inoculation has been devised which due to its simplicity and efficiency has proved very helpful.

A very few notes on this new method and its operation were advanced in the Report of the Division of Entomology, Annual Report of the Insular Experiment Station of Porto Rico, 1927–1928. The Director of the Insular Station, Mr. R. Fernández García, has informed us that he reported it at the Third Congress of the International Society of Sugar Cane Technologists held in Java in June 1929.

Mr. Authur H. Rosendfeld, in the February, 1930, number of the *International Sugar Journal,* commenting on the Java Meeting of the International Society of Sugar Cane Technologists when refering to the paper on "Mechanical Transmission of Mosaic" by Miss G. Wilbrink writes that:

> "During the discussion of this paper it was brought out that Mr. F. Seín had developed a simple method for the mechanical transmission of sugar-cane mosaic at the Porto Rico Insular Experiment Station for use in the testing out of varieties as regards natural resistance to the disease. The device seems to be a very simple one, consisting of a number of pin points at the end of a small handle, and, with this device, Mr. Seín has succeeded in a great many cases in transmitting mosaic from an affected plant to an unaffected one simple by pricking the leaves of the affected plant first and then proceeding to do the same thing with the leaves of the healthy plant."

As stated above by the author, his purpose in devising a new method of artificial inoculation was the study of how the causative principle of the disease is introduced into the tissues by the insect vector. The practical application of the new method in sugar-cane breeding work and in the study of the disease itself came up as secondary to the entomological problem which was contemplated. The reader will also become aware that the description of the method, the instrument used and the technique followed by the author are a little different from the description Mr. Rosenfeld has kindly advanced.

Since various mechanical methods for the artificial transmission of sugar-cane mosaic have been devised by previous investigators, and since there are divergent opinions on their efficiency, a review of the experimental work on this subject is desirable.

REVIEW OF THE LITERATURE ON THE TRANSMISSION OF SUGAR-CANE MOSAIC BY MECHANICAL MEANS

The mosaic disease of sugar cane was first reported from Java in 1890 by Dutch investigators who became convinced after unsuccessful attempts to transmit it artificially, that they were dealing with a bud variation rather than a disease. Kamerling (**9**), 1890, in Java reported successful infections obtained, we judge, by rubbing the lacerated leaves of healthy cane plants with the juice pressed out of mosaic plants. In the same publication Kamerling admits the occurrence of disease in his control plants and later Dutch investigators discredited his experiments. Kobus (**10**), van der Stok (**19**) and Wilbrink and Ledeboer (**21**), failed to produce the disease repeating Kamerling's experiments.

In America, Stevenson (**18**) was the first to work on sugar-cane mosaic. He began his studies at the Insular Experiment Station at Río Piedras, Porto Rico, in 1916, and continued them until 1919 but failed in all his attempts to transmit the disease artificially. Stevenson attempted to produce the disease by inoculating cane with pure cultures of several kinds of fungi; by hypodermic injections of the juices extracted from mosaic cane tissues; by placing the juice in holes made in the stalks; by inserting small bits of diseased tissue into various parts of healthy canes; and by rubbing the growing tips of the stalks after a diseased tip had been crushed in the fingers.

Tower (**20**), 1919, of the Federal Experiment Station, Mayagüez, P. R., failed to transmit sugar-cane mosaic by crushing and rubbing mealy bugs from diseased cane on developing buds and shoots of healthy canes, and by forcing the crushed bugs into punctures made in the buds and shoots.

Earle (6), 1920, at the Insular Experiment Station, P. R., performed a very large number of experiments in which he exhausted his ingenuity in the attempt to transmit the disease artificially and to reproduce the work of the unknown, but suspected insect vectors. The experiments were performed in the open and thus there was always the possibility of error. The percentage of infections in his inoculated canes was exceedingly low but Earle believed that a portion at least of these cases were caused by artificial inoculation. But he comments: "The fact remains, however, that the successes were much less frequent than the failures, that the best results could not always be duplicated and that the successful transfer of the disease is dependent on some factor or factors as yet absolutely undiscovered." Earle tried the following methods: rubbing or otherwise lacerating healthy leaves with diseased tissues; binding pieces of diseased tissue in contact with cut surfaces of healthy stalks; dropping bits of diseased tissue into the unrolled terminal leaf spindle and injections of the extracted juices by means of a hypodermic syringe. He also made a very interesting experiment in which a hypodermic needle was thrust into the soft tissue near the terminal bud of a diseased cane and then immediately inserted near the base of the unrolled leaf spindle of a healthy cane plant. There was no transmission in fifty attempts. This experiment although unsucessful is of interest to us because it is a departure from the attempt to imitate the work of a sucking insect. In a further experiment, where the attempt was to imitate the insect by extracting the juices from mosaic tissues and injecting them into healthy plants without exposure to the air, Earle was more successful. As this method was used later by Brandes and Bruner it is desirable to explain that upon the suggestion made by Mr. F. A. López Domínguez, Prof. Earle and Mr. E. D. Colón extracted the juice from the tender parts of mosaic cane plants by grinding with a pestle under a layer of mineral oil in a porcelain mortar. The juice was then taken up with a syringe, the needle of which was inserted through the oil layer, and injected immediately into healthy cane plants. With this method Earle was able to obtain five infections out of ten inoculated plants. On repeating the experiment two successive times, however, he was unable to obtain a single infection.

Matz (13), 1920, working also at the Insular Experiment Station, P. R., carried on an extensive series of complicated experiments in the endeavor to transmit sugar-cane mosaic artificially. His percentage of infection was extremely low and he concluded that "the exact method to insure takes is not known as yet". Matz tried the following methods: healthy and mosaic cane plants set in the same pots; healthy and diseased seed pieces split in half, a diseased half and a healthy half fastened together and then planted; healthy seed pieces watered with water in which diseased cane was allowed to stay for some time; and buds from healthy seed pieces inserted in diseased seed pieces and vice-versa, but no transfer of the disease took place.

Matz performed several experiments with juice pressed out of mosaic cane tissues exposed to the air. Healthy cane stalks in three pots inside the greenhouse were cut back leaving stumps about four inches above ground. There were one or more shoots about six inches high emerging from the base of the stumps. The juice was injected with a hypodermic needle into the stumps near the surface of the ground. The three shoots in one pot developed mosaic. The rest remained healthy. The experiment was repeated with twenty plants leaving twenty uninoculated as check. Two of the inoculated developed mosaic.

In another experiment ten cane plants were cut back, only a little above the growing point, five were inoculated in the cut surface of the top by injecting diseased juice with a hypodermic needle and five were left as checks. All remained healthy.

Next, twenty-five healthy stools in the greenhouse were cut back as in previous experiments and eight were inoculated with diseased juice and in addition, pieces of diseased cane were forced into small holes in the stems. All twenty-five plants remained healthy and *one of the checks developed the disease.*

The successful inoculations obtained in the first experiments were performed on cane more mature than that used in the last. To test this point eighteen seed pieces of mature Cristalina cane were cut to one or two eyes, twelve were inoculated near the base of the bud by boring a hole into the seed piece three-fourths inch deep and directly into it was pressed juice from diseased cane and six were inoculated in the same way with healthy cane juice. At the same time 35 Cristalina stools in a field that had just been cut were inoculated with juice in the stubble near the bases of sprouting buds. In both of these last two experiments not a single positive case developed. Matz remarks: "It was thought that by bringing in contact the cut ends of the vascular systems of diseased and healthy cane a transmission of the disease might take place. But no infection occurred". This is very interesting when compared with what Bonazzi reported in Cuba and Cook in Porto Rico later on.

The case of infection in his checks that we have specified is one of the several reported by Matz.

Smyth (**17**), 1920, at the Insular Station also performed twenty-seven experiments which consisted in crushing the juices of mosaic cane tissues into the leaf tissues of healthy cane plants, using very young, vigorous plants, and seventeen experiments which were attempts to transmit the disease by spreading quantities of finely-cut-up diseased tissue, either in juicy or dry condition, over the healthy plants and over the soil immediately surrounding them. All these forty-four tests gave negative results.

Lyon (**12**), 1921, in Hawaii, conducted numerous experiments in attempts to convey the disease by artificial means. The media most employed were juices extracted by pressure from various parts of affected canes, but more particularly from tissues adjacent to the growing point of the stem. Inoculation was attempted by applying these juices externally to all parts, and introducing them internally at various points in the stem, eyes and spindle with a needle-syringe. In no case did the disease appear on a high percentage of treated canes or canes from treated cuttings, and in every experiment it appeared on such a number of shoots in the checks as to invalidate the evidence of artificial infection. Most of these experiments were conducted under open field conditions and in a restricted area where the disease was at the time present in nearby canes. In the few experiments where canes grown in tubs and carefully isolated in a glass house were employed, only negative results were obtained.

Brandes (**1**), in 1920, performed his well-known experiments at Washington, D. C., in which he showed by eleven successful inoculations that mosaic could be transmitted artificially but under great difficulties. Bruner (**4**) remarks: "since Brandes' limited experiments were not repeated under the same or more natural conditions it is not sure that the same results could be duplicated."

In Brandes' experiments, "virus" was obtained for artificial inoculation by two methods. Cell sap from young leaves, designated as virus No. 1, was obtained by grinding the young, tightly rolled leaves of diseased Rayada cane in a food chopper and straining through several thicknesses of cheese cloth. It was used undiluted for inoculation immediately after being prepared. Virus No. 2, consisted of cane juice from the youngest joints, including the growing point. To prevent oxidation this was pressed out under a mineral oil (Nujol) in a specially designed press. This also was used undiluted as soon as prepared. Inoculations were made in a compartment of a fumigated greenhouse separated from all diseased material and protected by every means from accidental infection. The results of these inoculations show that where the virus No. 1 was used, one plant out of ten developed mosaic when the "youngest leaves were inoculated by numerous needle pricks." No more explanation as to Brandes' technique is given, but presumably the virus was smeared on the leaf surface and pricked in with the needle. Where virus No. 2 (extracted under oil) was used, presumably in identical manner, none of the ten plants developed the disease. Where ten plants were inoculated by injecting ½ cc., of virus No. 1 into the growing point with a hypodermic syringe, two out of ten developed mosaic, and where virus No. 2 was used in the same manner, eight out of ten became diseased. Brandes infers from these results that the sugarcane mosaic virus is highly infectious only when exacting demands in the matter of favorable conditions are satisfied. It is considered as proved, however, that the cell sap of diseased plants is infectious when introduced in the proper manner.

Bruner, (4), 1922, in Cuba published the results of his transmission expermients conducted, as he says "since we consider it necessary to be able to transmit the disease artificially before we can study it more thoroughly." Bruner repeated experiments made by Earle and Brandes. Twelve cane plants were inoculated by injecting juice from mosaic cane tissues extracted under oil. Castor oil was used and a few cubic centimeters of distilled water were placed in the bottom of the press before adding the oil: all inoculated plants remained healthy. Thirteen cane shoots were inoculated with juice obtained as in the previous experiment except that Nujol was used instead of castor oil: two developed the disease, or fifteen per cent. Ten plants were inoculated with juice obtained as in the last experiment but three injections performed in each plant: three of the inoculated plants became mosaic, or thirty per cent.

Thirty plants were divided in two groups and the plants in each group given two injections. Fifteen were inoculated immediately after extracting the juice exposed to the air: three became mosaic. Fifteen others were inoculated immediately after extracting the juice under Nujol oil: three developed the disease. Checks were kept in all these experiments. In no case did mosaic appear in the checks. From his experiments Bruner concludes that undoubtedly sugarcane mosaic can be transmitted artificially but that there is yet to be found a method which will produce a constant high percentage of infections since there is some factor that influences them which is not known.

Bruner performed also an experiment similar to the one performed by Earle, thrusting rapidly a fine hypodermic needle through a freshly cut mosaic cane leaf so that it would penetrate directly into the central nerve (or near to it) of the healthy leaf against which it was held in contact. This was done with the purpose of introducing the virus of the disease into the tissues of the healthy plant with the minimum waste of time and exposure to the air. In this manner, three leaves were inoculated in each plant; one tender, one mature and one old leaf, making three perforations in each leaf. Check plants were identically treated omitting only the diseased leaf.

Kind and condition of the plant: The plants inoculated were of the Cristalina variety, old ratoons about 1½ meters high in a field where infections of cane mosaic had never been observed.

Number of inoculated plants: 100 shoots in 23 stools
Date on which inoculated: December 6, 1920
No indications of infection: January 7, 1921
March 9, 1921:
  Stool No. 4 out of 4 shoots, 3 are mosaic
  Stool No. 5 out of 4 soots, 1 is mosaic
  Stool No. 18 out of 10 shoots, 4 are mosaic

All the check plants remained healthy. As further precaution against error, all the other stools in the field were examined and no infection was found in them. Bruner concludes that the eight plants inoculated became diseased as a result of the introduction into them of the infectious agent of mosaic when the perforations were made with the needle. Bruner, however, does not take into consideration that the virus of sugar-cane mosaic moves from one shoot to another in the same stool. This has been reported by Earle (**6**) and by Menéndez Ramos (**16**) and confirmed by the writer in unpublished experiments. Thus, there may have been only one successful inoculation in each stool.

Kunkel (**11**), in Hawaii, reports an experiment on mosaic transmission performed December 8, 1921. Undiluted juice pressed from the leaves and upper joints of diseased Lahaina cane was rubbed into wounds made on the leaves of six healthy Striped Tip cane plants. The leaves were wounded by crushing them between finger and thumb. The wounded tissue was inoculated by rubbing it with a small piece of absorbent cotton saturated with the diseased juice. Since no infections were obtained the inoculations were repeated December 26 and January 4, 1922. On April 7, five of the six plants inoculated had mosaic.

Fawcett (**7**), 1925, in Argentina has reported some very interesting experiments. His first attempt to transmit sugar-cane mosaic by wetting the leaves of healthy cane shoots fifty centimeters high with virulent cane juices failed, but upon repeating the experiment with five cane shoots ten to twenty centimeters high they all developed mosaic. At the end of three weeks the inoculated shoots showed well-marked symptoms of mosaic while eleven similar shoots growing close to them and left as checks remained healthy. Fawcett's paper is published in the Spanish translation and it is not clear whether the virulent cane juices were merely placed on the leaves or whether pieces of cotton wet with the juices were attached to the leaves. In either case, however, no perforations were made or the leaf surface broken up in any way. As an explanation, Fawcett says:

> "The other well-known disease: tobacco mosaic, is transmitted easily by contact. The application of sap from diseased plants to healthy plants is sufficient to produce infection. To determine whether sugar-cane mosaic can be transmitted in this manner, juices were extracted from mosaic cane leaves by cutting them into bits, adding a little distilled water, grinding and extracting by pressure."

It is evident that Fawcett attempted to transmit sugar-cane mosaic like tobacco mosaic and it is most remarkable that he was able to obtain 100 per cent infection with shoots ten to twenty centimeters high after having failed utterly with shoots fifty centimeters high. No one else has being able to transmit sugar-cane mosaic in this manner.

In another experiment, Fawcett inoculated the virulent juices into the tender leaves in the spindle a short distance above the growing point. He inoculated eleven shoots 10 to 20 centimeters high leaving twelve similar shoots untreated as checks. Between one and two cubic centimeters of virulent juices were inoculated into each shoot. Forty days later, seven out of the eleven inoculated shoots had developed mosaic and all the rest remained healthy.

On repeating the experiment, Fawcett inoculated five small shoots leaving similar shoots as checks. Twenty-four days later three out of the five inoculated shoots had developed mosaic. The others remained healthy.

It is very surprising to see that Fawcett should have obtained a higher percentage of infections when the virus was merely placed on the leaves rather than when it was injected. Fawcett, however, does not consider it significant and he adds:

> "The effect of injections is essentially the same as that of the application to the leaves differing only in that the virus is placed in contact with the surface of the tender leaves that have not yet expanded which undoubtedly

are more sensitive than the expanded leaves whose epidermis has already hardened.''

According to Fawcett, then, the virus of sugar-cane mosaic is capable of passing through the epidermis of the leaves and does not require the breaking of the epidermis to reach the tissues inside. We know of no other experimenter who has obtained similar results.

Bonazzi (5), 1926, Director of the Chaparra Experiment Station of Cuba published the following method for transmitting sugar-cane mosaic which he used on seed pieces of one bud each:

A hole is bored diagonally into the node, immediately above the leaf scar and as close as possible to the bud, without thereby impairing this tissue. For this work a 3 mm. sterile cork-borer is used, the small core thus resulting being kept to seal the wound at the site of inoculation. In the hole thus prepared a small piece of fresh apical bud tissue, obtained from an infected cane, is introduced and crushed by means of a sterile glass rod. The hole is closed by means of the cork-borer core and the wound finally, hermetically sealed with a small cotton plug soaked in melted paraffin. Planting is done soon after inoculation. The infected tissue for inoculation should be removed from a freshly exposed apical bud only a few seconds before use, the cut being renewed for every prelevation of a new inoculum, in order to avoid undue aeration.

Dr. Bonazzi reports a high percentage of infection in the treated seed pieces and none in the checks but he does not state whether these results were constant upon repeating the experiment. Neither does he explain what is meant by ''questionable infections'' five of which he reports among his treated plants.

Working at the same time at the Insular Station in Porto Rico as Dr. Bonazzi in Cuba, but independently, Dr. M. T. Cook devised and tested a method for artificially transmitting sugar-cane mosaic which he has informed the author is capable of producing a high percentage of infection in susceptible varieties. The method is somewhat similar to that of Bonazzi. A one bud seed piece is cut out of a healthy stalk leaving the bud in the center and part of the internodes at each end. One end is then hollowed out by removing with a knife the spongy tissues down as far as the bud or close to it. About half of the seed piece is thus emptied out into a hollow cylinder. A plug is prepared from the uppermost joints of a mosaic cane stalk by removing the hard outer covering and forced into the healthy cylinder. The grafted seed piece is then planted.

McRae (14), 1927, and McRae and Subramanian (15), 1928, in India have transmitted cane mosaic artificially by the following method: the cell contents of mosaic leaves were crushed out, then placed on leaves of healthy plants and pricked in with a sterile needle, controls having distilled water pricked in. In no case did the latter show any trace of disease, but mosaic was transferred from leaf to leaf or leaf sheath to leaf sheath in different canes; from various canes to maize and sorghum, but not to the lesser millets. This method seems to be the same used by Brandes, even though neither he nor McRae and Subramanian specify the kind of needle used. When inoculating from leaf of Co–213 to leaf of Co–213, McRae was able to obtain 8 infections out of 13; 8 out of 16 when inoculating from the same leaf to leaf sheath of the same variety of cane; and 16 out of 16 when inoculating from leaf of Red-Mauritius to leaf of Co–213. In no case did the controls produce mosaic markings. In contrasts to McRae's success it is interesting to remember that Brandes was able to obtain only 1 infection out of 20 inoculations using probably the same method.

No other method for artificially transmitting sugar-cane mosaic has been published up to date and the following statement by Hadden (8), 1928, sums up the situation: "Sugar-cane mosaic may be transmitted artificially by hypodermic injections, needle punctures, grafting, etc., but only with great difficulty and many failures."

Recently, at the Third Conference of the International Society of Sugar-Cane Technologists, held in Java, 1929, Dr. G. Wilbrink presented a paper to prove that sugar-cane mosaic can be transmitted by means of the knife used in cutting cane seed for planting. Dr. Wilbrinks's experimental plants, however, were exposed in the open to natural infection by *Aphis maidis* and the percentages of infection obtained were exceedingly low. It is claimed that the inoculum was carried and deposited on the cut surfaces of the healthy canes when they were sectioned later with the same knife. We have made a few tests of this method with complete failure and Matz (13) failed with a similar one. It seems rather improbable that it can produce infection.

This leaves as the most desirable and successful, the method used by Brandes and by McRae and Subramanian. This method, however, has not been tested under Porto Rican conditions.

A TEST OF THE METHOD USED BY BRANDES AND BY MCRAE AND SUBRAMANIAN

All the information given by Brandes (1) as to his technique is as follows: "Virus rubbed with fingers on unbroken surface of young leaves. Youngest leaves inoculated by numerous needle pricks."

All that McRae and Subramanian (15) say is: "In the infection experiments given in Table VI juice was crushed from mottled leaves and immediately pricked into leaf-sheaths and stems of plants known to be free from mosaic disease."

Neither Brandes nor McRae and Subramanian specify what size of needle was used in making their inoculations. In testing their method under Porto Rican conditions we used a row of two-hundred cane plants of the variety SC–12(4) set in a plot at considerable distance from other mosaic cane plants. The plot was practically free from weeds, but of course, being in the open, a certain amount of error from infestation by *Aphis maidis* was to be expected. To obtain the virulent juice for inoculation, tender mosaic sugar-cane leaves of the same variety were cut up into bits with scissors, pounded in a porcelain mortar, the ground mass tied up in a piece of muslin and the juice extracted under a hand press. All the utensils were carefully washed and the juice was collected in a clean beaker and used immediately after extraction.

One hundred shoots each in a different plant were inoculated leaving every other plant in the row as checks. To perform the inoculation, the mature, expanded leaves were bent down and some stripped off exposing the tender parts of the central spindle of tightly rolled young leaves. A little of the virulent juice was then placed on the spindle with the finger tip and as the drop of liquid slid downward it was pricked in with a No. 0 Asta black insect pin. Three drops were placed on each spindle and numerous needle pricks made. The inoculations were made April 25, 1929. Up to May 18, 1929, 52 out of the 100 inoculated shoots had developed mosaic and by June 25, 1929, when the experiment was closed, the number of infections had increased to 56. As the mosaic pattern became clearly marked, the infected plants were pulled out of the row to prevent natural transmission. In spite of this precaution, however, one case of secondary infection appeared in the checks.

DISCUSSION

There can be no doubt that sugar-cane mosaic can be transmitted by pricking the virulent juices into the young leaves. It is nevertheless very likely that were we to repeat the experiment, the results would vary. The extraction of the virulent juices is a troublesome procedure and since the virus seems to be readily destroyed or rendered non-infectious by exposure to the air the results would depend on the rapidity and care with which the work was done.

For the purposes we had in mind, the percentage of infection obtained by pricking in the virulent juices was not sufficiently high. The method itself was too troublesome for routine field work.

The direct pricking in of the inoculum from mosaic to healthy tissues had been attemptted by Earle (6) and by Bruner (4) with failure or low percentages of infection, but the instrument used by these investigators seemed to us to be too coarse. Disregarding the extraction of the juices as troublesome and subject to too much variation, we sought to devise a new method by improving on the work of Earle and Bruner through the use of a fine insect pin. In the new method as originally conceived, we depended on the spindle of tightly rolled tender mosaic leaves as the traditional source of the inoculum. Later, however, we found that the expanded leaves were a much more convenient and equally effective source of inoculum.

EVOLUTION OF THE NEW METHOD

THE SPINDLE-TO-SPINDLE METHOD

Adhering to the traditional source of inoculum—the spindle or cylinder of tightly rolled tender leaves—our first attempts at devising a new method of artificial transmission consisted in holding a spindle pulled out of a mosaic cane plant tight against the exposed spindle of a healthy cane plant and running an insect pin through the mosaic into the healthy tissues. A No. 2 white Asta insect pin was used thrusting it rapidly in and out at several points on both spindles. The results were proportional to the care taken in performing the inoculations, the condition of the cane plants and possibly other factors. When vigorously growing cane plants were inoculated carefully and rapidly, this spindle-to-spindle method could be depended upon to produce about 70 per cent infection. The method, however, had several disadvantages. Only one spindle can be obtained from one mosaic shoot and it is troublesome to hold the spindles tightly together when performing the inoculation. We used it nevertheless, with satisfactory results during the years 1925–1928 on different sugar-cane varieties. During the year 1928, the method was simplified by the use of expanded mosaic cane leaves instead of the spindles of tightly rolled tender leaves as the source of the inoculum.

THE LEAF-SLIP METHOD

Contrary to the traditional belief, the expanded leaves of mosaic sugar-cane plants are as good a source of the inoculum as the more tender ones. Any leaf as soon as it has expanded can be used. The very young ones split easily and the older ones are not pliable. The medium leaves are therefore more satisfactory.

THE TOOL

Black number 0 and white No. 2 Asta insect pins have been used. It is possible that a finer pin than the black No. 0 but sufficiently stiff to enter the tissues without bending will produce higher percentages of infection and require a smaller number of pin pricks to be made at each inoculation, but for ordinary routine work those that have been used are very satisfactory. Ordinary pins have proved worthless since apparently they are too thick and short and allow the entrance of air into the wound.

TECHNIQUE

We ordinarily use one pin at a time to make the inoculations, but several can be tied together into a brush thus making many pricks at one time. When the plants to be inoculated are large and their spindles thick, the brush of pins is very convenient. Before using the pin we usually cleanse it by running it through cloth or the midrib of a cane leaf. No attempt has been made to sterilize the pin. No other disease than mosaic has developed in the inoculated plants as a result of the pin pricks and it is perhaps needless to add that mosaic does not result from pin pricks or from pricking in the juice of healthy cane leaves into healthy cane plants.

When sugar-cane plants from two feet in height and upwards are to be inoculated the procedure is as follows: The expanded leaves are bent down and the central spindle exposed. The outermost one of the leaves, the basal part of which is still tightly wrapped about the spindle, is stripped off exposing the whitish cylinder of tender leaves.

A slip about one inch wide and some eight inches long is stripped off a mosaic leaf, this is placed like a band around the base of the exposed spindle and held tightly with the thumb and forefinger of the left hand. The pin, held in the right, is thrust rapidly in and out repeatedly through different parts of the mosaic band into the healthy spindle. The pin is thrust in a slanting position and is not made to go clear through the spindle. After the pin has been thrust in about twenty times, the mosaic leaf-band is moved upwards, held tightly again, and the pricking repeated at four or five points along the spindle using a fresh part of the mosaic leaf-band every time.

To inoculate very small cane plants whose stems are soft, the band of mosaic leaf is placed around the stem instead of the spindle. Corn and other grasses are inoculated in the same manner.

PERIOD OF INCUBATION

The period of incubation for sugar-cane mosaic is considered to be about fifteen days long. There is no difference in the length of the period between sugar-cane plants inoculated artificially by mechanical methods or through the agency of the insect vector, *Aphis maidis*, in nature.

The length of the period of incubation is measured by the appearance of the first symptoms of secondary infection. Since these symptoms appear in the tender leaves and not in those that were old or mature at the time of inoculation, it is obvious that the appearance of the symptoms depends on the rate at which the new leaves are growing and expanding.

ACCOUNT OF EXPERIMENTAL WORK

Only one experiment will be reported since it is representative of many others that were conducted. For lack of green-house facilities, they were all carried out in the open and therefore subject to error by the almost unavoidable liability to infestation by *Aphis maidis*.

A field near the Entomological Laboratory at the Insular Station, Río Piedras, P. R., was prepared in the usual manner and SC–12(4) cane planted in 14 parallel rows of 200 seed pieces each. The seed pieces were cut 1 foot long, planted 1 foot apart and the rows were spaced 3 feet apart. The seed came from one of the Station fields free from mosaic. After germination all the plants were examined and found to be healthy.

On August 24, 1928, the plants were about 4 feet high. All were inspected again and none were found with mosaic. In row No. 7, in the center of the field, 100 shoots, each in a different plant, were inoculated by the leaf-slip method and tagged. Alternate plants in the row were selected for inoculating thus leaving a check in between. As each seed piece had produced an average of five shoots there were some 13,000 shoots in the plot.

From September 8 to September 15, 1928, ninety-four of the one hundred inoculated cane shoots in row No. 7 developed mosaic. As soon as the symptoms of secondary infection were evident in the inoculated shoots, the entire plant to which it belonged was pulled out of the field. Up to September 15, 1928, when the experiment was closed no other case of secondary infection had appeared in the field except the 94 that had been inoculated.

On September 20, 1928, while looking over the field, two cases of secondary infection were found in cane plants that had not been inoculated artificially. One of the cases was near the outer borders of the plot, one out of a stool of four shoots; the other was in row No. 7, also one in a stool of five shoots.

Up to the time the experiment was closed no weeds had been allowed among the cane in the experimental plot. The finding of these two cases of secondary infection, evidently the result of natural transmission through the agency of *Aphis maidis*, is not surprising since the plot where the experiment was conducted was surrounded on two sides by fields of "malojillo" or Para grass, *Eriochloa subglabra*, a host plant of the insect, and on the other two sides by fields in which other host plants were also growing. A low percentage of natural transmission is to be expected in any such experiment conducted in the open.

DISCUSSION

Brandes (**3**) reached the following conclusion on the requirements for successful inoculation from his studies on the transmission of sugar-cane mosaic by *Aphis maidis:*

> "It has been found that a definite, measurable quantity of 'Virus' is necessary. This would eliminate from consideration as an explanation the carrying into the plant of the scanty amount of virulent material adhering to the minute mouth parts."

Brandes in the same publication shows by means of sections how the setae of *A. maidis* are inserted into the tissues of the corn leaf:

> "Typically, the setae of *A. maidis* pass through the sub-stomatal cavity, then through the mesophyll cells, either intercellularly or intracellularly, continuing between two cells of the starch sheath and finally into the phloem of the vascular bundle."

In devising our new method for accomplishing artificially what

A. maidis does in nature, we have started from a point opposite to that of Brandes in that we have assumed that possibly the scanty amount of "virus" adhering to the mouth parts might be sufficient to produce infection if it were conducted to the healthy tissues without undue exposure to the air. Whether the "virus" has to be carried to the phloem to produce infection or not, this is accomplished mechanically by thrusting the pin into the leaves a large number of times.

For lack of greenhouse facilities we have not attempted to determine the number of pin pricks necessary to produce infection. This would require a very large number of inoculations under conditions in which there would be no possibility for *A. maidis* gaining access to the plants. We have made some experiments in the open field in which lots of twenty cane plants each were pricked once, twice and three times, at the base, center and upper part of the spindles through mosaic cane slips thrusting the pin in and out as rapidly as possible. All such inoculations gave negative results and were not repeated since the very low percentage of infection to be expected would be questionable as there is always in the open field the possibility of infestation by *A. maidis*.

When a hundred or more pin pricks are made into each plant, the percentage of infection is so high and so constant that the danger of infection through *A. maidis* can be overlooked. In the first experiment reported above we selected the row of plants to be inoculated in the center of the field to minimize as far as possible the danger of infestation by *A. maidis* crawling in from outside or dropping down from the air. Lacking green-house facilities, this was the best that could be done. To further correct possible error, the only means we had was the repetition of the experiment a large number of times. The percentages of infection in all these repeated experiments conducted during the years 1925–1929 was as a rule over seventy with contrasting exceedingly low percentages of infection in the checks.

With green-house facilities soon to be available at the Insular Experiment Station, the experiment will be repeated under perfectly controlled conditions.

The plants were considered mosaic as soon as the symptoms of secondary infection became well marked. The symptoms as described by Stevenson (18), Brandes (2), Lyon (12) and others are unmistakable. The incubation period of about fifteen days is the normal for the disease. During the period of incubation, the soil was moist and the plants in the experiment were growing vigorously.

In using a pin for performing the inoculation, the limiting factor seems to be the exposure to the air of the "virus" that is carried on the pin. Success therefore depends on how rapidly the pin is thrust in and out. When the cane plants are growing vigorously the tissues are turgid and the sap is flowing freely. This probably favors infection because the wound made by the pin seems to close up on it thus excluding the air and possibly because the "virus" is rapidly distributed through the plant. Thrusting the pin in a slanting position would also favor the exclusion of air from the wound.

When resistant or immune varieties of sugar cane are inoculated, other factors are concerned of which as yet we do not know much about. Some of the sugar-cane plants inoculated artificially by us in our experiments and some of the checks that developed mosaic through the agency of *Aphis maidis* were transplanted and kept under observation for several years.

There is no difference between sugar-cane plants inoculated artificially with sugar-cane mosaic and those inoculated in nature by the insect vector of the disease, the corn aphid, *Aphis maidis Fitch.* The period of inoculation is the same, (varying naturally with the rate of growth of the plants), the symptoms and the manner in which they appear are identical and the course of the disease is the same in either case.

SUMMARY

1. A new mechanical method for artificially transmitting sugar cane mosaic has been developed and used at the Insular Experiment Station of Porto Rico during the years 1925–1929.
2. The method is very simple and easy to operate and produces constant high percentage of infection.
3. Former investigators had sought to transmit sugar-cane mosaic artificially by extracting the virulent juices and injecting them into the healthy plant by means of a hypodermic needle syringe or by pricking them in after smearing the leaves. The extraction and injection of the virulent juices is always troblesome and the "virus" is quickly rendered non-infectious possibly by exposure to the air. Such methods besides being laborious and troublesome do not produce constantly high percentages of infection.
4. Bruner obtained a few infections by pricking in the virulent juices directly from the mosaic into the healthy tissues without previous extraction. The percentages of infection obtained were quite low. This was possibly due to the use of too coarse a needle.

5. The spindle of tightly rolled tender leaves has been the traditional source of the inoculum in artificial transmission experiments. Our new method (spindle-to-spindle) originally consisted in pricking in the inoculum from a mosaic into a healthy spindle held tightly together. This arrangement, though producing a constant high percentage of infection was somewhat cumbersome.

6. In its final form the leaf-slip method consists in pricking in the inoculum from a slip of mosaic cane leaf held tightly as a band around the exposed spindle of a healthy cane plant. To inoculate small cane plants, corn and other grasses, the band is held around the stem.

7. Black No. 0 and white No. 2 Asta insect pins have been used with equally good results. Ordinary pins do not produce the desired results.

8. The number of pin pricks necessary to produce infection has not been determined. Experiments in which groups of cane plants were pricked one, two and three times each, failed to develop mosaic. Ordinarily, about a hundred pin pricks are sufficient to insure infection.

9. The limiting factor seems to be exposure of the "virus" to the air. By thrusting the pin in and out rapidly in a slanting position a large number of times if there are any other requirements for infection, they will be fulfilled mechanically. The larger the number of pricks made, the larger the number of chances for infection.

10. Using a bunch of pins tied up into a brush makes the inoculation work more rapid, especially when inoculating plants with a thick spindle. Equally good results have been obtained with a bunch as with only one pin at a time.

11. Success depends on the care taken to shorten the exposure to the air, of the "virus" that is carried on the pin and on the rate at which the inoculated plant is growing. In resistant or immune cane varieties, other factors are involved, of which we as yet do not know much about.

12. When the inoculated cane plant is growing vigorously, the tissues are turgid and the sap is flowing freely. This seems to favor infection because (1) the wound made by the pin closes up on it thus excluding the air and (2) possibly because the "virus" is carried and distributed rapidly through the plant.

13. Inoculated cane plants of susceptible varieties, when growing rapidly show the first symptoms of secondary infection usually fifteen days after the inoculation. The symptoms appear and are

in every respect identical with those shown by plants that have been inoculated through the agency of the insect vector of the disease, the corn aphid, *Aphis maidis* Fitch. The course of the disease is the same in sugar-cane plants inoculated artificially as it is in plants inoculated in nature through the agency of the insect vector.

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THE EFFECT OF SOME MOSAIC DISEASES ON CELL STRUCTURE AND ON THE CHLOROPLASTS

Melville T. Cook

The early studies on the mosaic diseases of plants brought out two points which have been accepted very generally by most of the workers who have studied the histology and cytology of these diseases. They are: ✓(1) the modifications of the cell structure of the leaf and ✓(2) the modifications of the chloroplasts. Attention was called to the modification of the cell structure by Beijerinck in 1899, by Woods 1900 and 1902, by Iwanowski in 1903 and by many others since that time. In 1899 Beijerinck expressed the opinion that mosaic of tobacco was a disease of the chlorophyll bodies and finally became a disease of the plastic contents of the cells. In 1899–1900 König stated that the chloroplasts were disorganized and the cell walls disappearing. Unfortunately this idea was quickly followed by the very widespread belief that the chlorosis or mosaic diseases were due to the disintegration of the chloroplasts and this opinion is very generally reflected in the literature of the past thirty years. However, the fact that the chlorotic areas of many diseased plants gradually become green with age and exposure to sunlight tends to throw doubt on the theory of disintegration of the chloroplasts. Furthermore, it is very evident that this theory could not be applied to all types of virus disease of plants.

The author of this paper has made a study of these two phases of the subject and is of the opinion that the active agent in the mosaic diseases recorded in this paper is inhibitory in both cases. In the first case the cells of the chlorotic areas are inhibited so that there is a reduced growth with little or no differentiation of cell and tissue structures. In the second case the chloroplasts of the chlorotic areas are small and few in number as a result of the inhibitory action of the disease, but these areas tend to develop the normal green color with age.

This paper will be devoted to a review of the literature and to the results of the author's studies on these two points. However, it should be remembered that these studies do not include a study of the lesions which frequently occur in connection with virus diseases of plants.

CELL STRUCTURE

Mayer (**27**) published the first important paper on a mosaic disease of a plant in 1886 but he did not record any histological studies. Iwanowski (**19**) says that Mayer made microscopic examinations of the juices only.

In 1899 Beijerinck (**3**) published the results of his studies in which he made two important statements: (1) that the green areas were diseased and the chlorotic areas normal, and (2) that the dividing or meristematic cells only could contract the disease. The first statement is incorrect because we now know that the active agent exists in both green and chlorotic areas and because later studies show that the chlorosis is the most conspicuous symptom of the disease. The second statement is more nearly correct because recent researches have shown that the histological modifications occur only when the active agent comes in contact with the meristematic cells before the tissues are fully differentiated.

In 1899 and 1900 Köning (**23**) and (**24**) published the results of histological studies on mosaic tobacco leaves including drawings of cross sections but did not report anything of importance. His statement that intercellular cavities occurred among both the palisade and mesophyil cells leads one to suspect that his studies did not include the very young leaves.

In the year 1900, Heintzel (**17**) published a paper on tobacco mosaic in which he called attention to the greater prominence of intercellular spaces in the dark green, bloated areas than in the light green areas and expressed the opinion that these spaces were filled with gas. Later studies have shown that the intercellular spaces or the dark green areas are normal, or nearly normal, and that the reduced intercellular spaces in chlorotic areas are abnormal. Therefore, we are inclined to believe that Heintzel was influenced by Beijerinck's idea which was prevalent for a time, that the dark green areas were abnormal and the cholorotic areas normal.

In this same year Woods (**35**) published a paper on tobacco mosaic which gives the first clear statement that has come to our attention concerning the histological character of the chlorotic areas as compared with the tissues from normally green plants. He says:

> "A study of the histology of the diseased leaves has now revealed a histological difference which makes it very clear that the light-colored areas are not normal, and this difference consists in the fact that in badly diseased plants the palisade parenchyma of the light-colored areas is not developed at all. All the tissue between the upper and lower epidermis consists of a spongy or respiratory parenchyma rather more closely packed than

normal. In moderately diseased plants the palisade parenchyma of the light area is greatly modified. Normally the palisade parenchyma cells of a healthy plant are from four to six times as long as broad. In a moderately diseased plant, however, the cells are nearly as broad as they are long, or at most not more than twice as long as broad. As a rule, the modified cells of the leaf pass abruptly into the normal cells of the green area. In a badly diseased leaf simply looking across the surface, with the naked eye shows depressions where the light areas occur, or where the leaf is mostly diseased the dark green patches are raised above the general surface.''

In 1902 Woods (36) also wrote as follows:

> ''Somewhat later I pointed out an important structural difference between the cells of the green areas and those of the light. In the latter, in the less pronounced cases of the disease, there is a shortening and broadening of the palisade parenchyma cells, and in the more pronounced cases there is an entire suppression of these cells, so that on simply looking across the surface of the leaf depressions are seen where the light areas occur and apparent blister-like development in the green areas. As a rule the modified cells pass abruptly into the normal cells of the green areas. The palisade cells of healthy leaves and of the healthy areas of diseased leaves are from three to four times as long as broad. Some plants are dark green, and these have the longest and narrowest palisade cells, closely packed with dark green chloroplasts, which seldom contain large starch grains. Other plants are much lighter in color. These have relatively broader palisade cells, approaching more in size and shape the spongy parenchyma cells of the same leaf. In both the light and the dark leaves the spongy parenchyma cells are about isodiagrametric, the diameter being about twice the length of the continuous palisade cells of the mature leaf.''

In this same paper he commented on the differences in the cell structures of the chlorotic and green areas as follows:

> ''The conditions which cause the disease are certainly only effective when acting on meristematic or dividing cells. It cannot be induced artificially, and never appears naturally in cells which have stopped dividing. A diseased spot, therefore, never increases in size in a leaf except as the disease cells themselves enlarge. The mosaic nature of the trouble and the fact that under some conditions the plants may grow out of the disease suggests that it must arise in such cases in the meristematic tissues behind the growing point, or where the plant is not mosaic, but evenly diseased, the pathological condition must be present throughout the cells of the growing point.''

In 1903 Iwanowski (19) published the results of extensive studies on tobacco mosaic and called attention to the error of Beijerinck who believed that the green areas was a true symptom of the disease. He says:

> ''When a diseased leaf is examined with care and compared with a sound one, a retardation of the development of the yellow spots is noticed; these are thinner than the greenish ones, and show a weak development on the obverse side.''

He also says:

> "A cross section of a green part gives the impression of a normal sound leaf, sometimes better developed than a sound one. The palisade and spongy parenchyma tissue are conspicuously differentiated.
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> * * * * * * *
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> "We obtain a different appearance when the preparation is made from the yellow part of the leaf. In this place the leaf is thinner than the green one, in a proportion of 2: 3. It was believed that the palisade tissue was not yet developed, in its place we find other cells; a comparison with the green parts showing that the longitudinal walls have not been formed but are already in their development stage. The inter-cellular spaces are completely formed; so that we can differentiate at once the green from the yellow parts with which the weak tissue has correlation."

In this same paper he said:

> "The parenchyma of the diseased leaves is more vigorously developed than those of the sound organs. In general the green parts seem hypertrophied and remind one of the forced development of tissue, on account of the presence of a parasite or insect injuries. This circumstance makes investigators of the mosaic diseases (Beijerinck) believe that the green spots are diseased and that the yellow are completely normal, and that they are only checked in their development or account of the deviation of the nutritive substances to the green parts of the leaves."

In this same year Bouygues (**4**) published a paper in which he reported the loss of the epidermis which was due probably to faulty technique.

In 1910 Westerdijk (**33**) published the results of studies on tomato mosaic, but the histological part did not add anything to our knowledge of the subject.

The next paper on this subject was by Melchers (**28**) in 1913 who made some studies on both tomato and potato. He reports that he did not find any abnormalities in the tomato, such as were described by Woods and Iwanowski for tobacco. However, he says—

> "* * * at times in the yellow areas this tissue (palisade) appeared slightly less developed than usual. The yellow areas were slightly thinner than the adjacent green areas, especially in older leaves."

Concerning the potato he says—

> "A microscopic study showed that the yellow areas were thinner at all ages; in some cases they were only 90 mic. thick as compared with 120 mic. in the normal leaf. This thinness was largely due to a shortening of the palisade cells which were of a striking cuboidal form. Sections from mottled areas were easily distinguished by the shape and size of the palisade cells. The cuboidal cells began very abruptly in some sections, while in other cases there was an intergradation between them and the normal palisade cells. In the yellow areas

as a rule, these cells were generally quite regular in shape, but sometimes there was less regularity. Their length varied from one-half to one-third that of normal cells and their thickness was usually slightly greater. The spongy parenchyma appeared normal in all areas, except that in the yellow regions, there were somewhat fewer chloroplasts.''

In 1917 Chapman (**6**) published a bulletin in which he gives some attention to the histology of the tobacco leaves which showed mosaic. He agrees in general with Woods but says—

> ''Occasionally the dark green areas showed a more closely packed parenchyma than in normal leaves, and *always the palisade was well developed* and approached the normal in character. The development or non-development of the palisade layer, as Woods hinted, is dependent on the degree of severity of the disease. The lighter the attack the less are palisade cells and parenchyma tissue altered and *vice-versa.*''

Chapman gives illustrations of cross sections from the normal tobacco leaf and from the green and chlorotic areas of mosaic leaves. These illustrations show that the palisade cells of the green areas and the intercellular spaces of the mesophyll are reduced as compared with the normal leaf. Also that the chlorotic areas are much thinner than the green areas, that the palisade is reduced to cuboidal cells and that the mesophyll is reduced and compact.

In 1920 Doolittle (**13**) published the results of his studies on the mosaic disease of cucurbits in which he described the anatomy of the leaves as follows:

> ''When stained sections of the leaves are examined, the palisade cells of the green areas are found to be crowded closely together and to be somewhat narrow and longer than those of the normal leaf. The palisade cells of the yellowed portion on the other hand, are more nearly isodiametric and less in number per unit area than in the normal leaf.
>
> ''The spongy parenchyma of these yellowed areas is also more compact and the intercellular spaces smaller than in the green portions.''

In 1922 Matsumoto (**26**) published the results of his studies on the azuki-bean in which he said—

> ''The anatomy of the diseased leaves is found to be identical with that of cucumber mosaic as described by Doolittle. The mesophyll of the dark-green parts of the diseased leaves is strikingly thicker than that of the light green or yellowed parts. The palisade cells of the former are markedly longer and narrower than those of the normal tissues. The corresponding cells of the light-green parts are much shorter than those of the normal ones, more or less isodiametric, and show a tendency to crowd together so closely that their intercellular spaces are almost invisible. The second important difference between these two different portions occurs in the spongy parenchyma. The spongy parenchyma of the light-green parts is also strikingly compact as compared with that of the dark-green areas. The chloroplasts of the former, as in cucumber mosaic, are slightly smaller and less in number than in the darker areas.''

In this same year Rand (29) published an extensive paper on the pecan rosette in which he says—

> "Within the yellow thin areas between the larger side veins (secondary stage) the tissue is usually less developed than normal, and the cells are more closely packed together. In less severe cases the palisade tissue is well developed, but the intercellular spaces become almost obliterated. In other instances the palisade cells are differentiated, but the individual cells are greatly shortened vertically and may be only two or three times as long as broad, instead of seven to ten times, as in the normal leaf. In the most severely affected leaves with extreme variation in leaf diameter there is no differentiation into palisade and sponge tissue at all in the center of these yellow spots, but the tissue within these parts of the leaf consists entirely of closely packed, more or less isodiametric cells without conspicuous air spaces. Under these conditions the number of cell divisions may be somewhat increased, the cells remaining smaller than normal. Usually, however, the number of divisions is reduced, and in some instances a parenchyma tissue only three cells deep has been found. Occasionally the entire tissue between the margin and midrib consists of undifferentiated cells. That this lack of differentiation is not due to immaturity was shown by examination of young healthy leaves just after their emergence from the bud. Even at this young and only partially expanded stage the palisade tissue of healthy leaves was found to be well differentiated.
>
> "In the thickened portions along the veins, or sometimes throughout the laminae in the aborted non-mottled leaves of depauperate rosettes, the size of cells may become increased in all three dimensions without essential change in ratio between spongy and palisade tissue. In some cases a slight increase in number of cell divisions also takes place. The individual cells appear abnormally healthy, and increase in leaf thickness here is due largely to increase in size of the individual cells. Along with this increase in cell size there is a reduction in size of intercellular spaces within the spongy parenchyma, and in the severely attacked leaf an almost complete obliteration of air spaces results.
>
> "Linear leaves may or may not show a differentiation into palisade and spongy tissue, but where the palisade cells are developed they are usually shortened vertically and the spongy cells of the parenchyma are more closely packed together than the cells in healthy leaves. The average thickness of these leaves tends to be less than normal and this reduction is due partly to decrease in the number of cell divisions and partly to the shortened vertical axis of the palisade cells. The elongated shape of the leaves, however, is not due to variations in cell shape but rather to a decrease in number of cell divisions in which the central spindles are perpendicular to the midrib. This would tend to keep the cells closer to the main water supply of the leaf."

Various other workers have called attention to the reduced thickness of the chlorotic areas and to modifications of the cell structures, but the most extensive work to date was published by Dickson (12) in 1922. His work was especially valuable because of the large number of species and varieties of plants which he used. He also appears to have been the first to report that in some cases two layers of palisade cells were developed, which he believed to be a hyperplasia caused by a late or slight stimulation of the meristematic cells. In speaking of the tobacco he says—

> "In a diseased leaf, however, there is a striking difference in the lamina thickness of the light and dark areas, the relative thickness being 180–200 and 270–300 microne, respectively, or a ration of 2 to 3. This is referable mostly to the difference in development of the palisade tissue in the two cases as was shown first by Woods. In the light areas the palisade parenchyma cells do not lengthen or do so to a limited extent depending on the severity of the infection. In most cases when leaves are severely infected the cells are cuboidal or isodiametric actual measurements showing variation from 20 to 60 microns in length and 17 to 28 microns in width. The cells of the spongy parenchyma in a healthy leaf are approximately twice as long as the palisade cells are wide, but in the light areas of diseased leaves the palisade cells are approximately equal in diameter to the underlying cells. This is due to the fact that the mesophyll cells are slightly smaller than in a healthy leaf, and that the normal division of cells in the palisade region is probably inhibited to some extent while the cells are meristematic. These cells are therefore in a hypoplastic condition as far as growth is concerned and the same applies to the cell contents as will be seen later.
>
> "By contrast the palisade cells of the dark areas are well developed and in all cases they are at least normal in size. The writer has found, however, a very common modification when the disease is severe. Instead of the palisade cells occupying a single layer there are two layers, the lower comprising cells somewhat shorter than those in the upper layer but being obviously palisade cells. In such cases the individual cells are also narrower so that equal lengths of cross section from moderately and severely diseased leaves gave palisade cells in the proportion of 6 to 10, respectively, counting the upper row only in the latter. This palisade tissue consequently occupies a relatively greater volume of the leaf and there is a considerable increase in the number of cells. Since they are well supplied with chloroplasts able to function we may assume that the photosynthetic efficiency of this tissue is increased. In view of the increase in volume it is obvious that the palisade tissue in severely diseased leaves is in a condition of hypertrophy and because of the increase in number of cells the hyperthrophy may be accounted for by assuming a condition of hyperplasia when the tissue was meristematic. Woods considered the palisade cells of the dark areas to be normal for he states that the 'modified cells pass abruptly into the normal cells of the green areas'. Chapman however, while using the term 'healthy cells' say that 'their structure may be somewhat modified by the increased functioning thrown on the healthy cells'. It is the writer's view that when infection is severe in any given meristematic cell that cell will be hypoplastic, but if it is infected later, or only slightly, then it will be stimulated either to hypertrophic growth or to hyperplasia. This would account for such instances above mentioned."

Space will not permit the quoting of Dickson's studies on other plants but in his summary he says:

> "Previous studies by other authors have been concerned chiefly with tobacco and in one or two cases with tomato and potato. In these no agreement is reached except in the finding of hypoplastic palisade tissue in lighter green areas of tobacco and potato and of fewer and paler chloroplasts in those areas.

"As a result of my studies with tobacco, tomato, potato, black henbane, petunia, pepper, sweet pea, Canada field pea, kidney bean, Windsor bean, raspberry, red clover, crimson clover, alsike clover, white Dutch clover and black medick it is clear that certain microscopic features are common to all the mosaic diseases studied. It is not to be understood, however, that in any leaf section from a diseased plant all characteristics, equally well developed, are to be observed. Much depends upon the growth rate and environment of the host plant but if sections are made from rapidly grown leaves of well-infected plants most of the following findings can easily be verified.

"There is a difference in the lamina thickness of light and dark parts of the leaf varying in amount and in the majority of cases giving a relative value of 2 to 3, respectively, where the disease is ordinarily severe. If the infection be slight there is less reduction in thickness of the lighter green parts but if the attack be unusually severe there is more reduction in the lighter parts and an increase in thickness of such parts as are dark green. Usually the dark green is but little thicker than an ordinary healthy leaf. This reduction in leaf thickness is due to hypoplasia of both palisade and spongy mesophyll cells but more especially to the former. There are all gradations from slight hypoplasia to that in which the cells are isodiametric and can only be determined as palisade cells by their position. It would appear that the hypoplastic condition of such cells is indicated also by the fact that they are usually somewhat wider that normal palisade cells. In a healthy leaf of tobacco, for example, a spongy mesophyll cell subtends approximately two palisade cells. Allowing that there is hypoplasia of the spongy mesophyll cells their reduced size is not very marked and yet only one hypoplastic palisade cell is needed to equal one mesophyll cell. This will be referred to again, but the point of view with regard to these palisade cells is that not only are they unable to develop in length but they must have been inhibited from further division when meristematic. In leaves where the attack is mild the palisade cells are narrower and longer, in fact nearly normal.

"The spongy mesophyll cells are also hypoplastic to a greater or less extent and when the disease is more severe they are equal in length to the width of the palisade cells above them. There is thus a very noticeable regular arrangement of the cells in the lighter green leaf parts."

* * * * * * *

"This regularity in cell arrangement necessarily reduces the proportion of intercellular space in the leaf, and by contrast there is usually an increase over normal in the intercellular spaces of hypertrophied parts."

Rawlins and Johnson (**30**) in 1925 published a paper on the cytology of mosaic tobacco in which they say—

"As has been found by other workers, the palisade cells in the chlorotic tissues are shorter and more nearly square in section than those in the nonchlorotic tissues of a mottled mosaic leaf or than those in healthy leaves."

In speaking of a section made from a plant which did not shown any symptoms of disease and in which the palisade cells were well developed, they say:

> "A leaf of this age will probably never become badly mottled. At least part of the chlorotic appearance in mottled leaves seems to be due to the failure of the palisade cells in the chlorotic part to elongate. It is a common field observation that, when old plants are inoculated with mosaic virus, the older leaves do not become mottled, only the young growing leaves developing this symptom."

In 1926 Goldstein (16) published the results of extensive studies on the cytology of healthy and diseased tobacco plants in which she says:

> "I find that the presence of the virus in the early stages in the histogenic development of the leaf results in the more severe types of mosaic patterns. Sections through the diseased leaves of tobacco plants, at all stages of their development, show that histogenic development was arrested in every case by the entrance of the virus. The distribution of the virus in the tissue is indicated by the stage in histogenic development which the various cell regions show. The lighter green regions of the leaf patterns were invaded before the dark green or normal green areas, which have continued their histogenic development to a latter stage. Sections through mature leaves, infected during the final stage of leaf development, show that the pattern is due to the effect of the disease upon the cell contents. In certain areas distributed through the leaf blade, such infections of leaves in later stages of histogenic development result in the faintly mottled apperance.
>
> "In my opinion the dark green areas represent regions which have escaped infection in the early stages of the entrance of the virus into the leaf primordium. They are able to go through their histogenic development for a time, but soon the toxins of the virus hinder the completion of histogenesis, as far as differentiation is concerned. The cells continue to enlarge, and can only do so by elongating, since they are bounded by cells which, owing to the presence of the virus, are not enlarging to any extent, and are rather rigid. When the cells of the dark regions divide, they are likewise under pressure from the surrounding light green regions which are enlarging more slowly, so that a buldging upward to form a blistered or puckered region (savoying) results.
>
> "As indicated in this seriation of the mosaic pattern types, the anatomical structure of a diseased leaf is correlated with the stage of its development when the virus entered it. When cuboidal cells are found in the light green areas of a given leaf, infection must have occurred at a very young stage and these cells have simply remained undifferentiated. The double palisade layer of the dark green areas, when studied from the developmental and histogenic standpoint, can be shown to be characteristic of young healthy green leaves at a certain stage of their development; neither has the hyperplastic development of a second layer of cells taken place, nor has hyperplasia of the cells themselves occurred in the dark green areas; the corresponding palisade cells of a leaf of mature development upon a mature plant may be much larger both in width and length than I have ever found them to be in the dark green regions of diseased leaves."

She also says:

> "I find that Iwanowski's and Dickson's statements as to the histology of the dark green areas are not incompatible. Both conditions can be found, depending on the age of the leaf at the time when infection took place. My sections through mature healthy leaves of mature plants show that in tobacco as in many other plants, a second layer of less elongated palisade cells may normally occur. The term hyperplasia as implying the development of a second layer of palisade cells should not be used in connection with the dark green areas of diseased tobacco leaves. These areas consist of seven layers of cells such as are characteristic of healthy mature leaves.
>
> "The cells found in the sections of the light green areas do constitute a hypoplastic condition due to severe infection, and represent the original embryonic condition of the leaf at the time when infection took place. Cytological study of very young leaves leads unquestionably to the conclusion that the entrance of the virus interferes with the histogenic development of the leaf. Embryonic cell layers of leaf primordia, which have been given an opportunity to develop before the entrance of the virus, show a normal palisade development. Furthermore, I find that the dark green areas, contrary to the opinion of Dickson are in reality also hypoplastic, and show a cell-form condition characteristic of a young stage in development of a normal leaf. The cells in such infected leaves soon cease to differentiate, and the palisade cells have simply elongated, producing the double palisade layer whose cells never attain the size of the cells found in mature healthy leaves. In accord with Küster's (1904) view of hyploplasia, such an arrested development should be considered as representing a hyporplastic condition."

In this same year Smith (**31**) published the results of her studies on mosaic diseases and leaf variegations. She states that the leaves of both healthy and diseased plants were of approximately the same age and the drawings show that these leaves were well advanced. Concerning her studies on *Datura stramonium* she says:

> "It was found in the histological studies that neither the green nor the chlorotic areas of the mosaic-infected plants are comparable to the normal, the green being thicker than the healthy, but showing normal tissue differentiation and distribution of plastids; whereas the chlorotic areas are approximately equal in thickness to those of the healthy, but have poorly differentiated palisade tissue and show a decrease in the number of plastids."

Concerning the *Phytolacca decandra* she says:

> "Here, as in *Datura,* it can be seen that the mosaic disease modifies the entire leaf, the dark green area being thicker than normal and the chlorotic region being reduced, particularly in the palisade layer. In this case also the healthy leaf is thinner than the dark green mosaic area but thicker than the chlorotic region. The thinness of the chlorotic sections is due chiefly to a lack of differentiation of the palisade layer."

She also reports a loss of the palisade cells in the chlorotic areas of a hybrid *Aquilegia,* a decrease in the thickness of the mesophyll and that "the healthy leaves are thinner than the dark green areas and thicker than the chlorotic regions".

In 1927 Sorokin (32) published a paper on tomato mosaic in which she agreed with the finding of Dickson. Speaking of a chlorotic region she says:

> "All cells are nearly isodiametric; there is no differentiation into palisade and spongy parenchyma; the intercellular space volume is very limited; the epidermal cells are hardly distinguishable from the parenchyma cells. The chlorotic regions in less severely diseased leaves are characterized by the fact that the first row of parenchyma cells are slightly longer than those of the other three or four rows." * * * "The spongy parenchyma and intercellular spaces are present and the epidermal cells are somewhat hypertrophied."

So far as the writer is able to determine from the descriptions and illustrations, none of the investigators with the exception of Goldstein have given careful attention to the ages of the leaves which they have studied. In many of these papers it is very evident that the studies were confined to the old leaves in which the tissues were differentiated so far as possible.

It is unnecessary to call the attention of the readers of this paper to the fact that a young leaf is composed of undifferentiated cells which undergo rapid differentiation with the growth of the leaf, resulting in the well known tissues of the leaf, long before the leaf is full sized. It is reasonable to suppose that the reaction of the plants would vary somewhat with the age and development of these meristematic cells and more or less well developed tissues at time of coming in contact with the active agent which causes the disease. In studies recorded in this paper and in others by the writer, a series of leaves from the youngest in which the disease could be detected to the oldest in which the pattern was sufficiently well defined to permit the selection of material, were studied. Comparative studies were made between the chlorotic and green areas of the same leaf and between chlorotic areas of diseased plants and leaves of the same age from healthy plants. It is the opinion of the writer that these studies have made it possible to follow some of the reactions of the plants to the diseases with a fair degree of accuracy.

In general it may be said that chlorotic areas are thinner than the normally green areas and that these areas vary in thickness, not only in different plants but in different leaves, and also in different areas of the same leaf. In general it may also be said that the histological variations are not so pronounced in the monocotyledonous as in the dicotyledonous plants.

The differences in the thickness of the leaves of diseased and healthy plants can be detected in very early stages of their development by studying buds from corresponding parts of diseased and healthy plants. Variations will be found frequently in a single leaf from a mosaic plant. Furthermore the cells in these thin areas are usually smaller than in normal leaves of approximately the same ages. These points are shown in figures 11 *a* and 11 *b* in which it will be readily seen that the diseased leaf (fig. 11 *b*) is thinner and the cells smaller than in the healthy leaf (fig. 11 *a*). As the leaves grow older the leaves from the healthy plant will develop the normal structure (figs. 12 *a*, 13 *a* & 14 *a*). The leaves from the diseased plant increase in size but the cell structure of the chlorotic areas are never normal. Sometimes they retain the structural character of undifferentiated cells throughout the life of the plant (fig. 12 *b*) while in other cases they approach the normal (figs. 13 *b*, 14 *b*, & 14 *c*). Sometimes they are almost normal in structure but modifications of the chloroplasts indicates that they are diseased.

Studies on other tobacco plants gave about the same history except that in most cases the chlorotic areas were thinner than the normal green leaves of the same age and the palisade poorly developed. The studies in general lead the author to believe that the poor differentiation in the first two leaves studied (figs. 11 *b*, & 12 *b*) as compared to the next two leaves studied (figs. 13 *b* & 14 *b*) was due to the fact that the first two leaves were younger at time of attack than the last two leaves.

The tomato plants used in these studies were infected with the same virus as the tobacco plants. The infections were severe and the symptoms very pronounced on the upper leaves; but the symptoms gradually disappeared with the increased age of the leaves. Several plants were used for study but all the drawings were made from the green and chlorotic areas of a single plant. The studies began with the youngest leaves in which the patterns could be detected with certainty. By this time, the palisade cells had developed in the green areas (fig. 15 *a*) but were very difficult to detect in the chlorotic areas (fig. 15 *b*). The chlorotic area was slightly thinner than the green area (figs. 15 *a*, *b*).

In the second leaf the development of the green area may be considered normal and complete (fig. 16 *a*). Sections from two chlorotic areas from opposite sides of the midrib of the same leaf (figs. 16 *b*, *c*) showed a variation in thickness, which is very common in all species that the writer has studied. The cell structure in both sections was very uniform, the palisade undeveloped and the intercellular spaces small.

The green area from the third leaf (fig. 17 *a*) was somewhat under developed as compared with the preceding leaf (fig. 16 *a*). The section from the chlorotic area (fig. 17 *b*) was slightly thinner than the green one (fig. 17 *a*), the palisade under developed and the mesophyll quite uniform.

The green part of the fourth leaf was thinner than the green parts of the third and second leaves but the structure may be considered normal or nearly normal. Sections from two chlorotic areas of this same leaf showed variations in thickness and structure (figs. 18 *b, c*). In one (fig. 18 *b*) there was practically no differentiation into palisade and mesophyll, while in the other (fig. 18 *c*) the differentiation was practically the same as in the green part.

The fact that the green areas of the third and fourth leaves (figs. 17 *a* & 18 *a*) were rather thin and under developed may or may not have been due to the disease. The author has noted that there may be considerable variation in the thickness of leaves of apparently healthy plants, regardless of ages. The partial development of the palisade cells in the chlorotic areas of the third and fourth leaves (figs. 17 *b* & 18 *b*) as compared with the lack of development in the first and second leaves (figs. 15 *b* & 16 *b*) is apparently due to the age of the leaves at time of attack. However it will be noted that sections from two chlorotic areas (figs. 18 *b* & *c*) of the fourth leaf show great variations in the development of the palisade. It is reasonable to suppose that this variation in development is due to an unequal distribution of the virus in the leaf.

The diseased cowpea plants used in these studies were very severely infected. Two sections from young normal leaves (figs. 19 *a* & *b*) and one section from an old leaf (fig. 20 *a*) show the line of development. In the very young leaf (fig. 19 *a*) the cell structure is undifferentiated. The differentiation is shown in figures 19 *b* and 20 *a*. The chlorotic areas in leaves of about the same age from diseased plants show remarkable variations in both thickness and structure (figs. 19 *c, d,* & 20 *b, c, d, e*). Here as in the tomato we find that two chlorotic areas from the same leaf may show variations in both thickness and structure. This is illustrated in figures 19 *c* and *d* which are from the same young leaf. Figure 19 *c* shows what is to be expected in a severely infected leaf; there is practically no differentiation. Fig. 19 *d* shows some differentiation but the condition of the chloroplasts indicate the infection. The variations in an older leaf are shown in figures 20 *b*, *c* and *d*. The section shown in figure 20 *b* was from a slightly chlorotic area. The thickness is the same as in the normal leaf (figure 20 *b*), the palisade consists of two layers of cells and the mesophyll cells are somewhat smaller and more compact than in a normal leaf or green area of a diseased leaf. Figures 20 *c, d, e,* were made from sections from old, severely diseased leaves. They are thinner than a normal leaf of the same age (fig. 20 *a*). The cells are rather large but meristematic in character except in figure 20 *d* in which there is a tendency towards the development of a palisade. These variations are probably due to the age of the leaves at the time they were penetrated by the active agent, or to the virulence of the active agent, or to unequal distribution of the active agent.

DISCUSSION

It is very generally recognized that the active agent is distributed throughout all parts of the plant, except the seeds, in which it has been found in only a few cases. It is also very generally recognized that the chlorotic areas are thinner than the green areas of the same leaf or a normal leaf of the same age. These studies show that these chlorotic areas may vary in thickness, even in the same leaf. In brief a leaf from a mosaic plant of tobacco, tomato or cowpea may show variations in thickness and structure ranging from a green area of normal thickness to a chlorotic area which is very thin and composed of undifferentiated mesophyll supported by an imperfect fibrovascular structure. All gradations in thickness and structure may occur between these two extremes. In some cases the only modification of structure is the formation of two layers of palisade cells.

So far as the author has been able to learn, Woods was the first to call attention to the reduced thickness of the chlorotic areas and this has been confirmed by most investigators since that time. He also called attention to "the fact that in badly diseased plants the palisade parenchyma of the light colored areas is not developed at all. All the tissue between the upper and lower epidermis consists of a spongy or respiratory parenchyma rather more closely packed than normal". He also stated that "the conditions which cause the disease are certainly only effective when acting on the meristematic or dividing cells".

Since that time many investigators have confirmed Wood's opinion that chlorotic areas were thinner than the green areas and that the palisade was undeveloped. However, no one appears to have been impressed with the idea that the structural variations were due to the action of the active agent on the meristematic tissue until the publication of Dickson's paper (12) in 1922. He said:

"It is the writer's view that when the infection is severe in any given meristematic cell that cell will be hypoplastic; but if it is infected later, or only slightly, then it will be stimulated either to hypertrophic growth or to hyperplasia.''

The writer agrees with the first statement of Dickson but not with the latter. The studies on which this paper is based indicate that the active agent which causes the disease is inhibitory. It produces a hypoplasia by inhibiting the differentiation of the meristematic tissues. The writer does not find hypertrophy in any of the cases studied, which are usually classified under the general term of mosaic.

So far as the writer has been able to learn Goldstein (16) was the first to assert that ''the virus interfered with the histogenic development of the leaf'' and that ''the distribution of the virus was indicated by the stage in histogenic development''. The studies of the writer very generally confirm the results reported by Goldstein.

It is very evident to the writer that the active agent inhibits the growth and differentiation of the meristematic cells. It is also evident to the writer that the active agent does not cause a change on any of the leaf tissues after they have completed their normal development. The variations in the histogenic structures found in the different chlorotic areas as recorded in this paper may be due to any one of several causes:

1. The amount of the virus or active agent injected into the plant and carried to the meristematic region.
2. The growth activity of the host plant at the time.
3. The relative virulence of the active agent.
4. The relative age of the tissue at time when it comes in contact with the active agent.
5. The unequal distribution of the active agent throughout the leaf.

The growth of the tissues of chlorotic and green areas is not the same. In some cases the differences in growth are so great as to cause a deformity. This is especially noticeable in the tobacco where it results in the formation of pockets in the green areas. This pocketing is evidently due to the fact that the growth in the chlorotic areas has been slowed up while that of the green areas appears to be normal or nearly normal.

The differentiation of the tissues in the chlorotic areas is inhibited and the growth and division of the cells is slowed up to some extent. The result is that the chlorotic areas increase in size as a result of the division and growth of the cells. However, there is no evidence to indicate that it increases in size as a result of the invasion of the active agent after the tissues are mature. Woods (36) appears to have been the first to call attention to this point when he said:

> "A diseased spot, therefore, never increases in size in a leaf except as the diseased cells themselves enlarge."

The writer of this paper confirmed this idea for sugar cane in a paper published in 1926 (10) by the following statement:

> "These areas increases in size with the growth of the leaves, but so far as the writer has been able to determine they do not encroach on the surrounding tissues and do not coalesce. The increase in size appears to be by cell division and growth and not by infection of surrounding cells."

CHLOROPLASTS

It is very generally recognized that the very young leaves of most plants are white or very light green and that those which have a mosaic disease show very faint or no mosaic patterns whatever until they have been exposed to sunlight and begin to turn green. In the case of normal plants the young leaves become uniformally green very rapidly when exposed to sunlight. In the case of plants infected with mosaic, certain areas become normal green very quickly while certain others remain light green or yellowish for a time displaying the well known pattern of mosaic and then in most cases gradually become green until the pattern almost or completely disappears. This has been observed by a number of writers and appears to be true for most plants. The most notable exceptions are the lettuce as reported by Jagger and the *Abutilon hirtum* which will be discussed by the writer in a later paper. Jagger (20) in his discussion of the lettuce mosaic says:

> "The first symptom of disease was a yellowish discoloration along the smaller veins of the younger expanded leaves. This symptom was usually evident for only a few days, giving way to a general yellowish, discolored appearance of the whole plant. All gradations of discoloration occurred from very marked to conditions not distinguishable with certainty from normal."

This statement indicates that the discolorations become more pronounced with age which is not in harmony with most descriptions of mosaic symptoms; but he further says:

> "Often plants that showed marked discolorations, mottling, and stunting soon after becoming diseased would later seem to recover in part and to make a more or less normal growth with only slight discoloration and mottling."

This last statement indicates that the patterns disappear in some cases and the plants tend to become green with age as described for most mosaic diseases. In the *Abutilon hirtum* which will be discussed in a later paper some of the spots become slightly greener with age while others remain chlorotic.

This tendency for the chlorotic areas to become green with age and exposure to sunlight led the writer to doubt the generally accepted idea that the chlorotic condition was the result of a disintegration of the chloroplasts as stated by several writers. If the chloroplasts undergo disintegration, these chlorotic areas ought to become more chlorotic instead of green. Therefore, the writer began a series of studies on this phase of the mosaic problem some years ago and the results were first presented in a paper published (**9**) in 1925. This was followed by a paper (**11**) which was read before the Philadelphia meeting of the American Phytopathological Society in 1926 and published in 1927 (**10**). These papers were received with more or less differences of opinion. The writer having made his studies almost entirely on sugar cane, which had not been used by any of the other workers on this phase of the subject, decided to continue the studies and to use a number of other species of plants. The plants used were the common red canna (*Canna indica*), tobacco and tomato, all of which have been studied by other workers, cowpea which has been studied to some extent and *Abutilon hirtum.* The readers will note that the sugar cane and canna are both monocotyledonous while all the other are dicotyledonous. This may be of some importance because in the first two the leaves are rolled while in all the others they are folded and because the cell structures are somewhat different.

Before giving the results of these studies on chloroplasts, it is desirable to give a brief review of the literature to date. Mayer (**27**) referred to the chloroplasts in mosaic of plants and said that mosaic was a disease of the plasmatic cell contents. Köning (**23** & **24**) reported a disorganization of chloroplasts and a disappearance of the cell walls, which leads the writer to suspect that he studied old leaves and that the conditions were due to other causes. The statement that the chloroplasts were disorganized or disintegrating appears to have been generally accepted until the writer of this paper published (**9**) evidence to the contrary in 1925 (see page 88).

Beijerink (**3**) defined the mosaic of tobacco as a disease of the chlorophyll bodies which finally became a disease of the plasmatic contents of the cells. However, he did not give an explanation of his results. The writer is of the opinion that he also was working with old leaves.

Woods (**35**) in the conclusions of his first paper makes the very definite statement—"Chlorophyll is destroyed rapidly by oxidizing enzymes, of which two groups are recognized,—oxidases and perioxirases", but he does not explain why the chlorotic areas become green with age.

In 1902 he said (36):

> "That the disease is not primarily of the chloroplasts, as Beijerinck thought, is evident from the fact that in the less pronounced cases the chloroplasts, though fewer in number are not decreased in size or activity. * * * In some pronounced cases the chloroplasts are light colored or wholly without color."

Iwanowski (19) published a paper in 1903 in which he said:

> "If we now turn our attention to the cell contents, there is a lack of chloroplasts which are not regularly distributed in the palisade parenchyma. Investigation on the live-stage shows swollen chloroplasts which have the appearance of big drops with green, fine circles around them. Sometimes these drops fill the whole cell, rarely the chloroplasts are scattered ,and the cell contents is of a pale green color. As in the beginning of the observation and because of the rapid preparation of the solution, such formations appear rarely, we have to accept that they are more properly an artificial product, a continuation of the resistance capacity of the chloroplasts of the yellow parts in comparison with the green. In the last ones no such scattering of the chloroplasts has been seen.
>
> "The chloroplasts on the yellow parts have a pale yellow color, with a granular structure. At first there is no vigor, cuts on new leaves treated with iodine showed a great difference; in the green parts an intense color, in the yellow, not a vigorous granule. Examinations with the naked eye showed that a diseased leaf after being treated with iodine showed color in dark blue and yellow sections, while the dark blue sections corresponding to the green parts. Later on, the vigor shows on the yellow parts also."

Baur (1) reported in 1904 that in *Abutilon thompsoni* there was no evidence of a causal organism but that the plastids in the chlorotic areas were reduced in size and number.

In 1910 Westerdijk (33) reported the chloroplasts of tomato mosaic as slightly smaller than normal, yellowish and containing but little starch. Melchers (28) reported in 1913 that the chloroplasts in the chlorotic areas of mosaic potatoes were fewer and of a pale yellowish green. Doolittle (13) reported in 1920 that the chloroplasts in the cells of the chlorotic areas of the cucumber were smaller than in green leaves and that they were located so very close to the cell walls as to be almost invisible.

In 1915 Clinton (7) said:

> "Very frequently, especially where the chlorosis is of the mosaic or variegated type, it seems to start in the very young tissues, and not after the leaves are fully grown.

In 1920 Doolittle (13) published a paper on the mosaic of cucurbits in which he said:

> "The chloroplasts of the cells of the yellowed portions are decidedly smaller than in normal cells and are often pressed so closely to the walls of the cells as to be almost invisible. In contrast to this the chloroplasts in the dark-green areas are so large and numerous as to seem to fill the cells. The vascular elements of mosaic show little variation from the normal."

Kunkel in 1921 in his paper (25) on a mosaic disease of corn says:

> "Even before the leaves unfold and while they are still quite white the diseased areas appear translucent and can readily be distinguished from the portions of tissue, which on exposure to light will become deep green. As the leaf unfolds in the light and becomes green the outlines of the diseased spots or stripes become more clearly marked. The light color of the diseased areas is due to a failure of these portions to develop the normal green color rather than to a fading of the green color after it has once been produced."

Dickson (12) in his studies on a large number of plants frequently refers to the reduced number of chloroplasts in the chlorotic areas but shows that he is a believer in the disintegration theory by several statements. In his discussion of the tobacco mosaic he says:

> "The carbohydrate content is not the same in light and dark-green areas is indicated by the iodine test. The chloroplasts and grains in the lighter-green areas take on a brown stain, even when there is little obvious change in the chlorophyll apparatus, and the amount of carbohydrate is less because of the fewer chloroplasts.
>
> "The chlorotic condition of the lighter areas is not due to lack of iron in the plastid as is clearly indicated in the following tests."

After giving these tests he continues:

> "The only cells in which this was difficult to demonstrate for individual plastids were those containing many tiny hyaline masses resulting from their break down. It is possible of course, that in such cases we have a hypoplastic condition under which the normal plastids did not develop originally but it appears more probable from my observations that this is a case of degeneration."

In his discussion of the potato mosaic he says:

> "The chloroplasts of the cells of the light areas are fewer in number and paler in color than in the dark green but there are fewer instances of chloroplast degeneration than in tobacco. In the dark green tissues the chlorophyll content is always at least equal to the normal and sometimes above that of healthy tissue."

Again in his summary of the results of microscopic studies (p. 49) he says:

> "Corresponding with the hypoplastic condition of the cells there is a gradation of hyploplasia and degeneration of the cell contents. Cells, slightly

> affected as far as growth is concerned may be different from healthy cells only in the slightly paler green of the chlorophyll while the chloroplasts appear to be present in nearly normal number. With increase in severity of effect on cell size there is a very definite reduction in the number and of depth of color of the chloroplasts and in some instances they are also reduced in size.''

Johnston (22) says in speaking of sugar cane that—

> ''This mottling character is most clearly seen in the inner newly developed leaves, often fading out in the mature leaves. It is not seen in any very young shoots.''

He also says—

> ''A gradual disappearing of the mosaic in old leaves.''

In 1925 Rawlins and Johnson (30) published their studies on the cytology of mosaic tobacco in which they said:

> ''From the drawings it is evident that in this leaf the palisade cells and their chloroplasts are well developed. A leaf of this age will probably never become badly mottled. At least part of the chlorotic appearance in mottled leaves seems to be due to the failure of the palisade cells in the chlorotic part to elongate. It is a common field observation that, when old plants are inoculated with mosaic virus, the older leaves do not become mottled, only the young growing leaves developing this symptom.''

In the writer's first paper on this subject in which the studies were restricted almost entirely to sugar cane attention was called to smaller number and small size of the chloroplasts in the chlorotic areas as compared with the green areas and normal cane. The writer said:

> ''A study of the cells of these leaves shows that the chloroplasts are more numerous in the dark geen than in the light green areas. Therefore, it appears that in the case of the light green areas the formation of the chloroplasts is inhibited but that with the exposure to sunlight this inhibition is gradually overcome.

* * * * * * *

> ''The chloroplasts in the white or yellow areas were fewer in number and smaller than in the green areas.

* * * * * * *

> ''The small chloroplasts of the mosaic cells are usually spoken of as having undergone a process of degeneration. The writer has studied the chloroplasts in the very young unrolled leaves and is satisfied that these chloroplasts are undeveloped rather than disintegrated. They have never reached normal development. Furthermore a study in a series of leaves from those just unrolling to the outermost on a plant shows that the chloroplasts of both normal and mosaic cells increase in size after being exposed to light. These changes which are apparently due to age or light are so pronounced that there is very little difference in size of chloroplasts in old leaves of diseased plant and the chloroplasts

in a leaf of the same age from a healthy plant. The writer is very doubtful if disintegration over occurs in case of primary infection (*i. e.* infection from the seed).''

In the paper (**11**) read before the Phliadelphia meeting (1926) of the American Phytopathological Society the writer expressed the opinion that—

''The chloroplasts are not destroyed nor even injured by the diseases. Their development however is inhibited.''

In the more complete paper (**10**) on this subject the writer said:

''The chloroplasts in the sheathing cells of a healthy plant are large and the markings well defined as compared with the chloroplasts from the corresponding cell of a diseased plant which are small and with poorly defined markings. The chloroplasts in the ordinary mesophyll cells of a healthy plant are large and regular as compared with the chloroplasts from the corresponding cells of a diseased plant. However, as previously stated, the chloroplasts in the chlorotic areas in the older leaves of a diseased plant are very nearly or quite normal in appearance. No disintegration of the chloroplasts was observed in any case except in very old leaves which were decaying from old age or in tissues which were decaying as a result of attacks of fungi.''

The writer also said:

''The tendency of leaves of diseased plants of both sugar cane and tobacco to become more or less uniformily green with age and exposure to sunlight is no doubt due to tendency of the chloroplasts in the cells of the chlorotic areas to increase in number and size. This could not possibly be the case if the chloroplasts were undergoing disintegration.''

In 1926 Eckerson (**15**) reported the finding of flagellate organisms living in and destroying the chloroplasts in plants infected with tomato mosaic.

In this same year, Jones (**21**) described a mycetozoan (*Plasmodiophora tabaci*) from tobacco plants. He says:

''Disintegration of chloroplasts apparently is the first visible response on the part of the cell to the presence of the organism. Later the cell walls disintegrate and disappear.''

In the following year Sorokin (**32**) published a paper on ''Phenomena Associated with the Destruction of the Chloroplasts in Tomato Mosaic'' in which she gives a short review of the literature and a lengthy discussion of her experiments.

In the summary of the paper Sorokin says:

''The chloroplasts are destroyed through the dissolution of the proteins of the stroma. This fact is easily demonstrated by direct observation of the living material and by microchemical tests. The same is confirmed by study of the material fixed under the microscope, or fixed and stained by usual cytological methods.

"The normal chloroplasts are rather solid. The first indication of a pathological condition is the appeearance of rapidly moving hyaline bodies within the chloroplasts. The movement of these bodies is possible only after liquification of the stroma of the chloroplasts has taken place. Therefore it is assumed that a proteolytic enzyme, possibly secreted by an organism, is present. An increased osmotic concentration results inside of the chloroplasts, and water is taken in from the surrounding medium. Finally, the entire body of the chloroplasts goes into solution and, if sufficient water is present in the surrounding medium, spherical transparent vesicles result.

"The sphere represents a membrane resulting from the digested chloroplast in which the digestion products and water are retained, the whole being surrounded by a surface film at the interface. The spheres give negative protein reactions, and are soluble in alcohol, acetone, or acids. They are soluble in weak alkali. They can be fixed and stained by methods used in the study of the inclusion of the animal virus diseases."

In this same year Bremer (5) published the results of his studies on the cytology of the stripe disease of sugar cane and other plants in which he gave some attention to the chloroplasts. He reports a reduction in the size of the chloroplasts in some species and varieties but not in others. In one place he says:

"The chlorophyll grains are very irregularly scattered and are absorbed to a large extent by the stripe-diseased body"

which indicates a belief in the theory of disintegration.

In another place he says:

"I also found that, in most cane species, the chlorophyll had a lighter green color, in the light-green areas, the chlorophy grains not having reduced in size. In Betoeng I Rokan and Kapoer I Rokan, both species showing entirely white stripes on the leaves, most of the chlorophyll grains had remained small, owing to the disease. There even were chlorophyll grains that could hardly have been seen when strongly magnified, while they were entirely wanting in many cells. The very small chlorophyll grains were colorless. In mosaic Hippeastrum and Eucharis, I found also that in cases where the color of the leaves was lighter green, the chlorophyll grains had remained smaller than in healthy plants."

However, his figure No. 1 shows a healthy cell in which the chloroplasts are large and a diseased cell in which they are small.

In 1927 Hoggan published the results of her studies on the virus diseases of Solanaceous plants (18) in which she made the following statement:

"Where the external symptoms of mottling or chlorosis were marked, the chlorophyll had changed from green to yellow, and the plastids were reduced in size, in severe cases of disease sometimes disintegrating and apparently breaking up into small particles. In leaves infected when very young, the chloroplasts did not develop normally but remained small and fewer in number than in the healthy cell. When placed in water, these plastids often swelled up to form colorless vesicles as described by Iwanowski (19), and it is thought possible that this may have some bearing on the formation of the 'spheres' reported by Sorokin (32).''

This brief review of the literature will show that the theory of disintegration of the chloroplasts as advanced by Köning and Beijerinck was very generally accepted by most workers without question until 1925 when the writer (9) advanced the theory of inhibition.

This theory of inhibition of the chloroplasts was well received by some workers but was not accepted by others. This difference of opinion led to the more extensive studies which are reported in this paper. However, before taking up the additional data we will review the results of the work on sugar cane as given in the authors last paper. In this connection the attention of the reader is called to the fact that the leaves of the sugar cane do not have a well defined layer of palisade cells such as is found in the leaves of most plants. However, the leaves of the sugar cane do have two distinct types of parenchyma cells: (1) a single layer of long tubular cells forming a sheath around the fibro-vascular bundles, and (2) ordinary parenchyma cells which are irregular in size and form and constitute the true mesophyll of the leaf.

Cross sections of leaves of healthy plants beginning with the inner leaves (figs. 1 *a*, 1 *c*, 1 *e*)* show that the number and size of the chloroplasts is practically the same throughout the series from oldest to youngest leaves. This is also shown in longitudinal sections through these sheathing cells (figs. 3 *a*, 3 *c*, 3 *e*) and in sections through the ordinary mesophyll cells (figs. 5 *a*, 5 *c*, 5*e*). But similar sections through the chlorotic areas of mosaic leaves of the same ages and positions as the leaves on the healthy plants showed that the chloroplasts were few and small in the cells of the inner leaves but increased in size and number in successive leaves from the youngest or intermost to the oldest or outermost leaf (figs. 2, 4 and 6). These studies were made on a number of different plants and the results were always the same. There was no evidence of disintegration of the chloroplasts except in the very old leaves in which some of the cells were abnormal as a result of old age or the attacks of fungi. All these studies were made from sections cut from leaves fresh from the plant and studied immediately and from sections made from leaves which had been killed and fixed a few minutes after collecting.

It appears to the writer that this tendency of the chloroplasts to become normal in number and size is due to the exposure to sunlight rather than to age. Both normal and diseased canes were germinated and grown so far as possible in a dark room and both remained chlorotic.

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* This series includes five leaves. The drawings have been made from numbers 1, 3 and 5. However, studies have been made on a series of seventeen leaves from a single

The mosaic disease was discovered in our plots of red canna (*Canis indica*) but unfortunately all the plants were diseased and it was impossible to compare the normal with the mosaic plants. The patterns disappeared very quickly with age and exposure to sunlight, so that is was impossible to find the patterns on the fifth leaf. However, it was very easy to compare section from the green and light colored areas of the four youngest leaves. Sections were made from the leaves that were just unrolling as soon as the patterns were sufficiently distinct to show the boundaries and from the second, third and fourth leaves. No sections were made from the fifth leaves because the patterns were practically lost and because they were infected with rust fungi (*Puccinia cannae* (Went.) P. Henn.)

An examination of sections (fig. 7 *a*) from the green parts of the innermost or youngest leaves showed numerous, well developed chloroplasts while an examination of sections (fig. 10 *a*) from the green parts of the fourth leaf showed no differences or only slight increases in size and number of chloroplasts. An examination of sections (fig. 7 *b*) from the chlorotic areas of the inner or youngest leaf showed very few and small chloroplasts, while an examination of sections from the light areas from the second (fig. 8), third (fig. 9) and fourth (fig. 10 *b*) leaves showed a gradual increase in the number and size of the chloroplasts from the innermost or youngest to the oldest or outermost of the leaves. This is in harmony with the conditions recorded for the leaves of the sugar cane and indicates that there is a true inhibition of the development of the chloroplasts in the chlorotic areas which is partially overcome by age and exposure to sunlight.

Sections were made from a series of leaves of a healthy tobacco plant beginning with very small leaves and ending with leaves about seven inches in length (figs. 11 *a*, 12 *a*, 13 *a*, 14 *a*) showed a gradual increase in the number and size of the chloroplasts. This differs from the sugar cane and canna in the fact that the chloroplasts are fewer and smaller in the young than in the old leaves. A study of sections from the chlorotic areas of corresponding leaves from diseased plants showed that in the youngest leaves (fig. 11 *b*) there were no chloroplasts, in the second leaf there were a few small chloroplasts (fig. 12 *b*), while in the third leaves there was an increase in number and size of the chloroplasts (fig. 13 b) but that the increase was not so great as in the corresponding leaves from healthy plants (figs. 12 *a*, 13 *a*). However, in the fourth leaves from the diseased plants (figs. 14 *b*, 14 *c*) the chloroplasts were almost equal in number and size to those in the healthy leaf (fig. 14 *a*). The presence of the palisade layer of cells the third and fourth leaves (figs. 13 *b*, 14 *b* and *c*). The short palisade cells in 14 *c* indicates a more severe infection than in 14 *b*. The tendency of the chloroplasts to increase in size and number with age and exposure to sunlight is in harmony with the preceding studies.

In the study of the tomato plants there was some doubts as to whether any of the plants were absolutely free from the disease. Therefore, it was considered advisable to compare sections from the green and chlorotic areas of the same plant. The youngest leaf in this study was not so young as the youngest leaf used in the tobacco studies as shown by the fact that the palisade in the green area of the youngest leaf (fig. 15 *a*) was farther advanced than the palisade in the green area of the youngest leaf of the tobacco (fig. 11 *a*). The chloroplasts in the green areas of the tomato plant were very numerous and fairly regular in size in all the leaves from the youngest to the oldest (figs. 15 *a*, 16 *a*, 17 *a*, 18 *a*). However, the cell structure of both the third and fourth leaves (figs. 17 *a* and 18 *a*) indicates a slight infection as compared with the second leaf (fig. 16 *a*). In the chlorotic area of the first leaf (fig. 15 *b*) there were no chloroplasts; in the chlorotic areas of the second leaf (fig. 16 *b* and *c*) the chloroplasts were few and small. In the section from a chlorotic area of the third leaf (fig. 17 *b*) which showed a palisade layer, indicating late or slight infection, the chloroplasts were larger and much more numerous than in the second leaf. Sections from two chlorotic areas of the fourth leaf (figs. 18 *b* and *c*) show an increase in number and size of chloroplasts. These sections also show a condition which is quite different in both the tobacco and the tomato in that the structural development is more advanced in one than in the other, which the writer interprets as indicating that the infection was either more severe or earlier in the one than in the other. It should also be noted that in the section from a chlorotic area in which the palisade was well developed (fig. 18 *c*) the chloroplasts were fully as abundant as in the sections from green areas (fig. 18 *a*) but that they were much smaller. In this as in the preceding, the study of the sections indicates an inhibition of the chloroplasts which is partially overcome with age and exposure to sunlight.

The studies on the cowpea were less extensive than on the other plants but included both healthy and diseased plants. The very youngest normal leaf studied did not show any differentiation into the palisade and mesophyll yet the chloroplasts were numerous and large (fig. 19 *a*). In a slightly older normal leaf in which the palisade was fairly well developed the chloroplasts were equally numerous and larger (fig. 19 *b*). In a fully developed normal leaf the chloroplasts were abundant and considerably larger (fig. 20 *a*). Two sections (figs. 19 *c*, and *d*) from a young mosaic leaf of about the same age as the second normal leaf (fig. 19 *b*) showed quite different conditions although they were from the same chlorotic area. In one (fig. 19 *c*) the palisade was very slightly developed and the chloroplasts few, small and very irregular in size. In other sections from the same area (fig 19 *d*), the palisade was almost normal, the chloroplasts almost as abundant as in the section from the normal leaf (fig. 19 *b*) but very irregular in size. A section (fig. 20 *b*) made from the green part of a severely infected leaf showed the same thickness as the section from the normal leaf (fig. 20 *a*) but the chloroplasts were fewer and irregular in size. Three sections made from chlorotic areas of the same diseased leaf (figs. 20 *c*, *d*, *e*) showed that these areas were less than one-half as thick as the normal leaf (fig. 20 *a*) or the green areas of the diseased leaf (fig. 20 *b*) and that the palisade in all cases was under developed. The number of the chloroplasts varied in three sections but they were smaller than in the normal leaf. These studies also show inhibition of the chloroplasts but that the inhibition is overcome with age and exposure to sunlight. They also show that the disease varies in different parts of the same leaf as in the tobacco and tomato which may be due to the age of these areas at time of infection or to severity of infection.

A study of the chloroplasts in a series of leaves from the youngest to the oldest in which the mosaic patterns can be distinguished shows very clearly that the chloroplasts are fewer and smaller in the chlorotic areas than in the green areas of diseased plants or than in the leaves of normal green parts of corresponding ages. They also show that the chloroplasts increase in size and number with age and exposure to sunlight. It should also be noted that there are variations in different areas of the same leaf and in the same area. These variations are apparently dependent on the age of the various areas of the leaves at time of infection or on the severity of these infections or on both. The fact that the leaf is not of a uniform color indicates variations of infection of some kind. The writer is inclined to believe that the active agent spreads unevenly through the leaf and that those areas which are attacked earliest or most severely by the active agent show the greatest amount of inhibition.

These studies on the plastids indicate that in the case of the normal plant and in the green parts of the diseased plants, the chloroplasts are well developed when the leaves open. There is some increase with age but it is not marked. The plastids in the chlorotic areas are few in number and small in size but increase rapidly in number and size with age and exposure to light, and in some cases become almost normal. The writer failed in finding any evidence of disintegration of any kind in either the chloroplasts or cell walls.

Iwanowski (**19**) figures large circles or spheres and the writer has found the same thing in both tobacco and sugar cane. It was impossible to trace any connection between them and the plastids and they appear to be quite different from the spheres described by Sorokin (**32**).

In 1926 Beauverie published a paper (**2**) on the degeneration of chloroplasts, especially in parasitised parts in which he also discussed degeneration as provoked by artificial methods but the author of this paper is unable to determine to what extent his results are comparable to the results described by the students of virus diseases.

The writer found many plastids that appeared to be swollen and either empty or filled with a colorless fluid. They varied in form from spherical to spindle shaped. These were formed in abundance in both diseased and apparently healthy tissues.

Very little has been done in the way of chemical studies on the mosaic diseases of plants but there are two papers that have a bearing on the work of the author. In 1919 Colón (**8**) published a paper on the mosaic disease of the sugar cane in which he said:

> "Now, the absorption spectra obtained for the alcoholic (ethyl) solution of chlorophyll from newly yellow-striped young leaves did not in our tests and under the same conditions exhibit any differences from the absorption spectra obtained for the alcoholic (ethyl) solution of healthy young leaves.
>
> * * * * * * *
>
> "Should there have occurred any decomposition of the chlorophyll in the diseased leaves, the absorption spectra obtained form the examination of the alcoholic solution of their chlorophyll would not have, in the first place, been identical with the absorption spectra similarly obtained from healthy leaves. New bands or a modification of the old bands would in all probabilities have been noted, since other cane pigments and many decomposition products of chlorophyll are known to have characteristic absorption spectra. The fact that the decomposition of the chlorophyll would, in the case of the sugar cane, have developed in an acid medium would have defined all the more the changes to be expected since the acid decomposition products of chlorophyll are fairly well known."

In 1928 Dunlap (14) published a paper which he summarized as follows:

> "1. The mosaic disease of tobacco reduces the chlorophyll (*a–b*) content below that of normal plants.
>
> "2. A lower-than-normal chlorophyll content is characteristic of mosaic tobacco plants at all stages of growth.
>
> "3. The amount of green pigment in any mosaic leaf of a tobacco plant is below normal.
>
> "4. The clorophyll content of young tissues is somewhat more seriously affected by tobacco mosaic than older tissues.
>
> "5. Older tobacco plants, after infection with mosaic virus, were found to contain subnormal amounts of chlorophyll, especially in the leaves that developed after infection.
>
> "6. The total chlorophyll content of mosaic tobacco plants is seriously reduced."

The results given in these two papers appear to be in harmony with the work of the writer of this paper.

Motile bodies were found in the cells of tobacco, tomato and sugar cane. They were found in the mesophyll, epidermal and hair cells of both diseased and healthy plants. They were never found in the chloroplasts as described by both Eckerson and Sorokin.

SUMMARY

1. This paper is a record of comparative studies on mosaic and healthy plants of sugar cane, canna, tobacco, tomato and cowpea. They deal entirely with the cell structure and cell contents of the chlorotic areas as compared with the green areas of the same plants and with healthy plants. They do not include studies of lesions. The comparisons in every case were made on tissues of corresponding ages.

2. The cell structure of a very young leaf of a normal plant is very uniform, but the differentiation begins very early and is practically complete long before the leaves are full sized.

3. The chlorotic areas of mosaic leaves are thinner than the green areas of the same leaves or than normal leaves of corresponding ages.

4. The active agent inhibits the differentiation of the cell structure from the time that the two come in contact. If the active agent comes in contact with the meristematic tissue at an early period in its development, the structure remains undifferentiated; if at a later period, the tissues remain in the stage of development at time of attack.

5. The spread of the active agent through the leaf appears to be

very uneven, which accounts for the mottling and the variations in development in different parts of the leaf.

6. The reaction of the leaf may depend on the age of the leaf at the time of infection, to the virulence of the virus or to the amount of virus; but the fact that we find variations in both thickness and cell structure in a single leaf and sometimes within a single area indicates that there may be an unequal distribution of the virus throughout the plant or throughout an organ of the plant. This is substantiated by the many records of plants (especially tobacco plants) in which one side only showed the symptoms and of leaves in which the symptoms were more severe on one side than on the other.

7. There is no reason to believe that the cell structure is modified by the virus or active agent. The tissue is inhibited in its development and remains at practically the same stage as when attacked by the virus. There is some growth but it is rarely if ever as rapid as in the green areas or in normal leaves.

8. There is no evidence that the chlorotic area increases in size as a result of the spread of the virus into the green cells adjacent to the chlorotic areas. The chlorotic areas increase in size as a result of cell division and growth of chlorotic areas.

9. The variations in growth of tissues in the bloating of the green areas or pocketing which is so common in mosaic tobacco and to the various deformities in other plants.

10. The development of the plastids is inhibited in both size and number. In the very young, growing leaves, it is difficult to locate them in either fresh or stained material but they develop rapidly with age and exposure to sunlight. The mosaic pattern gradually fades and in many cases cannot be detected in the older leaves.

11. The chloroplasts increase in size and number with age and exposure to sunlight.

12. The author did not find any evidence of disintegration of the chloroplasts.

13. In cases of non-infectious chlorosis, the plants did not become green with age and the chloroplasts did not increase in size and number with age and exposure to sunlight.

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EXPLANATION OF PLATES

PLATE III

Figs. 1 *a*, *c*, *e*. Cross sections of normal leaves of sugar cane. *a*. leaf just open; *c*. 3rd. leaf; *e*. 5th leaf. The large cells are sheathing cells which lie next to the fibro vascular bundles. Note that the chloroplasts are normal and practically the same throughout.

Figs. 2 *a*, *c*, *e*. Cross section from corresponding leaves from mosaic plant. Note that the chloroplasts are few in number and small but improve with age.

PLATE IV

Figs. 3 *a, c, e.*	Longitudinal sections through sheath cells of same as Fig. 1.
Figs. 4 *a, c, e.*	Same for mosaic plants.

PLATE V

Figs. 5 *a, c, e.*	Section through parenchyma or mesophyll cells. Same as 1 & 3.
Figs. 6 *a, c, e.*	Same as 2 & 4.

PLATE VI

Fig. 7 *a.*	Canna green part. First leaf rolled. All leaves diseased.
Fig. 7 *b.*	Canna chlorotic part. First leaf rolled.
Fig. 8.	Canna chlorotic part. Second leaf unrolled.
Fig. 9.	Canna chlorotic part. 3rd leaf unrolled.
Fig. 10 *a.*	Canna green part. 4th leaf unrolled.
Fig. 10 *b.*	Canna green part. 4th leaf unrolled.

PLATE VII

Fig. 11 *a.*	Tobacco. Normal leaf in bud. Slightly younger than 11*b*.
Fig. 11 *b.*	Tobacco. Mosaic leaf in bud. Note that the cell structure of *a* and *b* are practically the same. Also that there are plastids in 11 *a* and none in 11 *b*.
Fig. 12 *a.*	Tobacco. Normal leaf. About 2 inches in length.
Fig. 12 *b.*	Tobacco. Mosaic leaf. Less than 2 inches in length.
Figs. 12 *a* & *b.*	Same age. Note the difference in thickness and that 12 *a* has the palisade tissue. Also the difference in the chloroplasts.

PLATE VIII

Fig. 13 *a.*	Tobacco. Normal leaf. About 3½ inches; rather thin.
Fig. 13 *b.*	Tobacco. Mosaic leaf. About 3½ inches. Note that these two leaves are practically the same except that development of the chlorophyll is better in *a* than in *b*.
Fig. 13 *c.*	Tobacco. Mosaic leaf. Same age as 13 *b*. The infection more severe and palisade poorly developed.

PLATE IX

Fig. 14 *a.*	Tobacco. Normal leaf. About 6 & 8 inches.
Figs. 14 *b* & *c.*	Tobacco. Mosaic leaf. About 6 & 8 inches. The disease in both *b* and *c* is mild; the palisade is well developed but the chloroplasts reduced.

PLATE X

Fig. 15 *a*.	Tomato leaf. Green part. Youngest leaf.
Fig. 15 *b*.	Tomato leaf. Chlorotic part. Youngest leaf. Note the difference in cell structure and chloroplasts.
Fig. 16 *a*.	Tomato leaf. Green part. 2nd leaf.
Figs. 16 *b* & *c*.	Tomato leaf. Chlorotic part. 2nd. leaf.
Figs. *b* and *c*.	From same section of leaflet. One on one side of midrib and one on other. Note difference in structure and chloroplasts. Also compare with 16 *a* and with 15 *a* and *b*.

PLATE XI

Fig. 17 *a*.	Tomato leaf. Green part. 3 leaf.
Fig. 17 *b*.	Tomato leaf. Cholorotic part. 3 leaf. This leaf was attacked later than 16 *a*. The structure is slightly reduced and the chloroplasts decidedly reduced.
Fig. 18 *a*.	Tomato leaf. Green part. 4 leaf.
Figs. 18 *b*, *c*.	Tomato leaf. Chlorotic part. 4 leaf.
	Fig. *b* was attacked early and *c* late. Note difference in structure. Compare chloroplasts with 18 *a*.

PLATE XII

Fig. 19 *a*.	Cowpea. Very young leaf. Normal.
Fig. 19 *b*.	Cowpea. Young leaf. Normal.
Fig. 19 *c*.	Cowpea. Young leaf. Mosaic.
Fig. 19 *d*.	Cowpea. Same leaf. Mosaic.
	Compare structure and chloroplasts; *c* and *d* are from same leaf which shows that the disease was more severe in one part than in the other.

PLATE XIII

Fig. 20 *a*.	Cowpea. Old leaf. Normal.
Fig. 20 *b*.	Cowpea. Old leaf. Mosaic. Green part. Note the double layer of palisade and compare chloroplasts. The disease in this case was very mild.

PLATE XIV

Fig. 20 *c*.	Cowpea. Old leaf. Mosaic. Severe.
Fig. 20 *d*.	Cowpea. Old leaf. Mosaic.
Fig. 20 *e*.	Cowpea. Old leaf. Mosaic.
	Note that the cell structure in *c*, *d* & *e* is abnormal but that the chloroplasts tend to recover.

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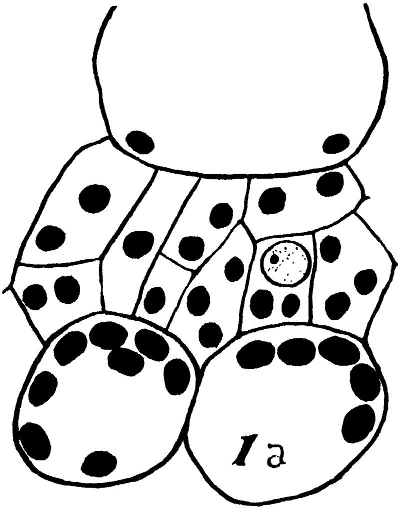
PLATE III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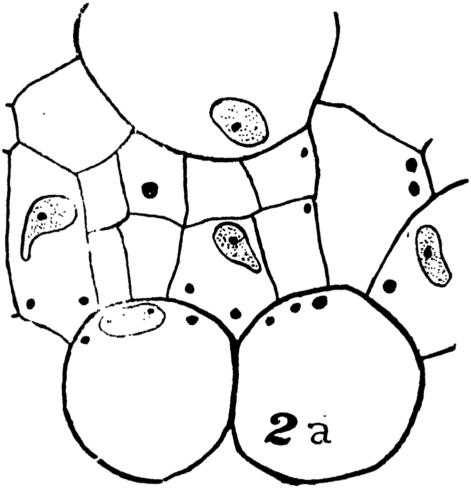
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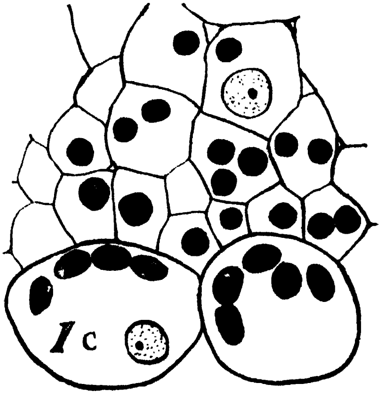
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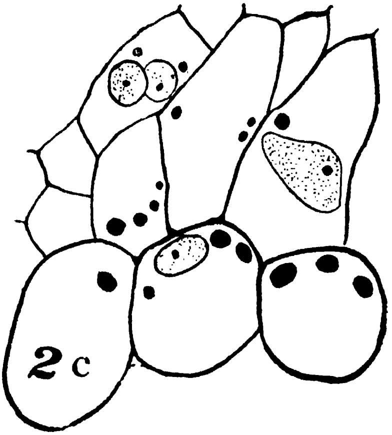
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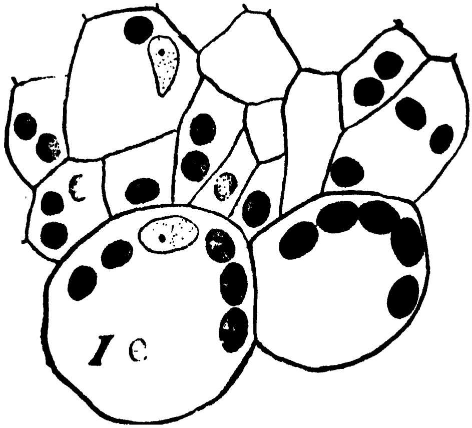
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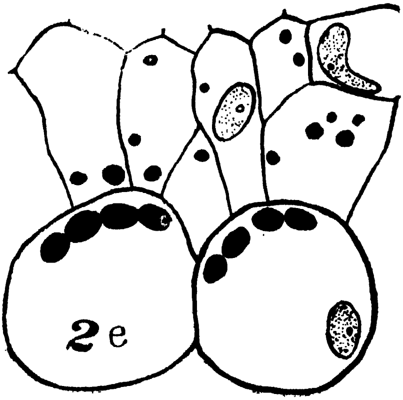
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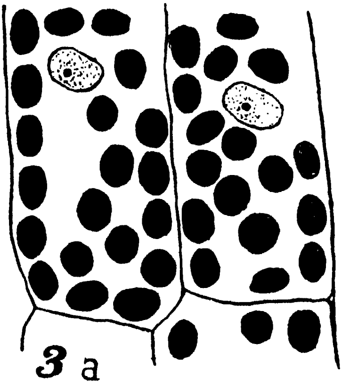

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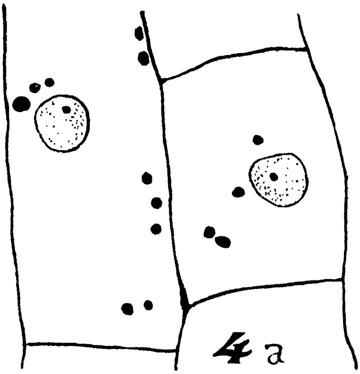

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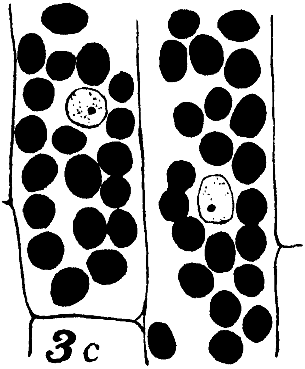

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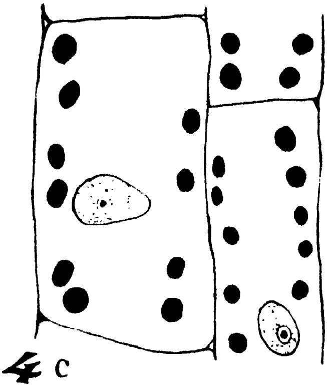

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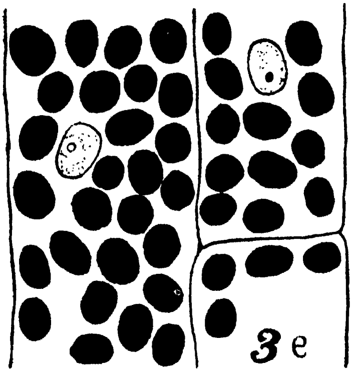

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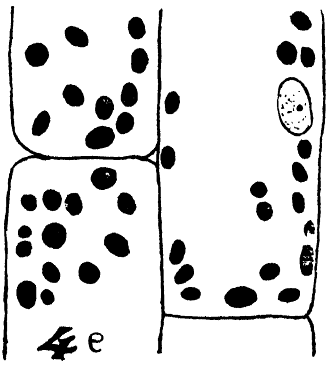

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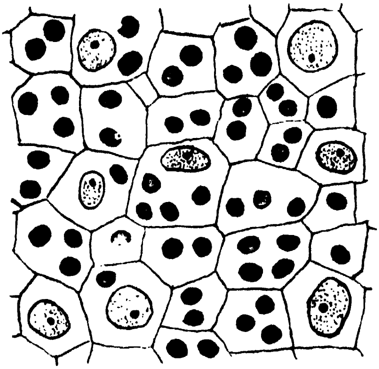

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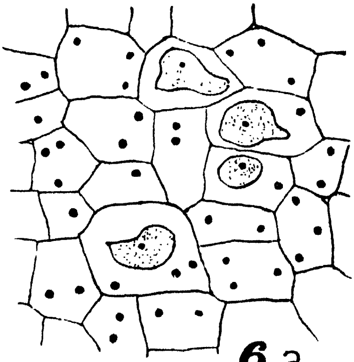

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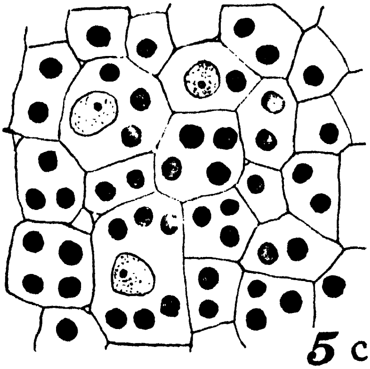

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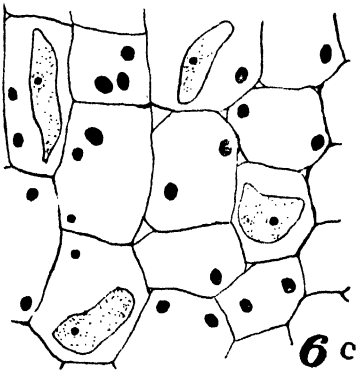

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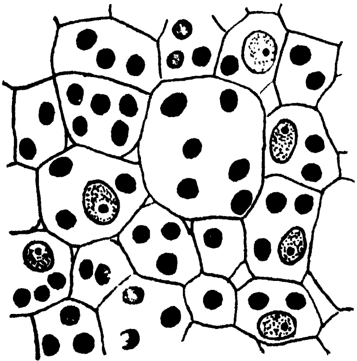

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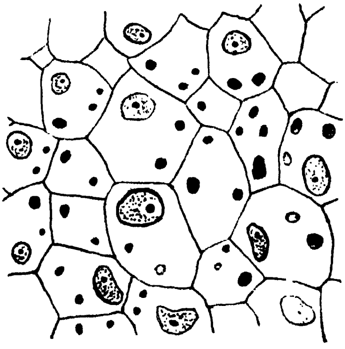

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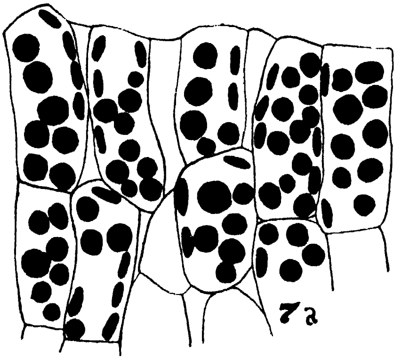

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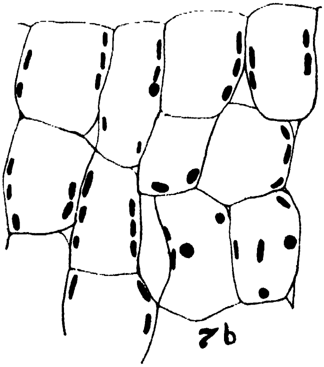

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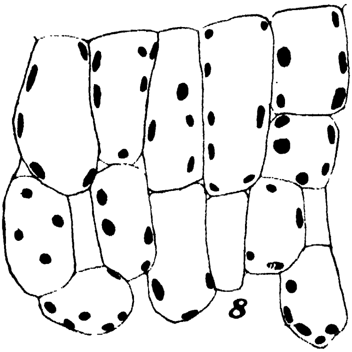

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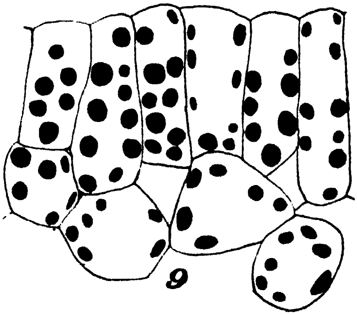

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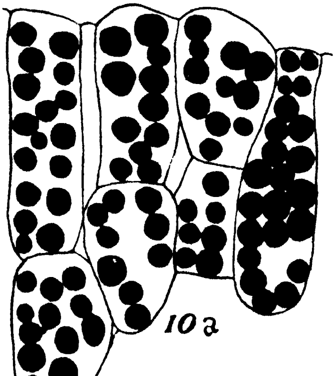

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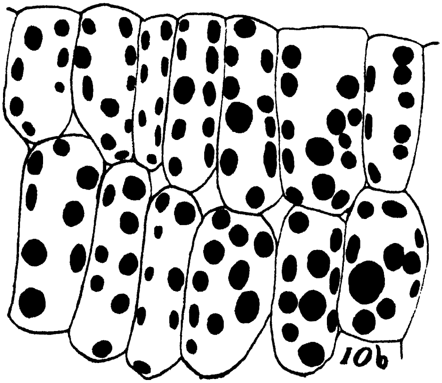

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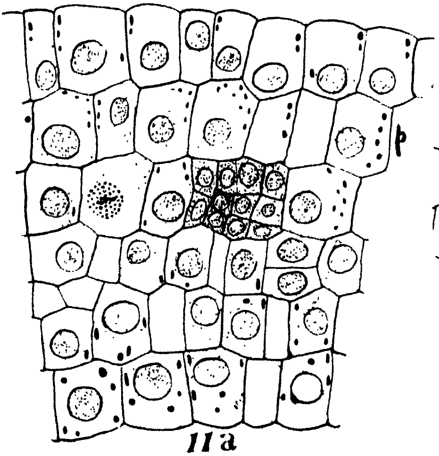

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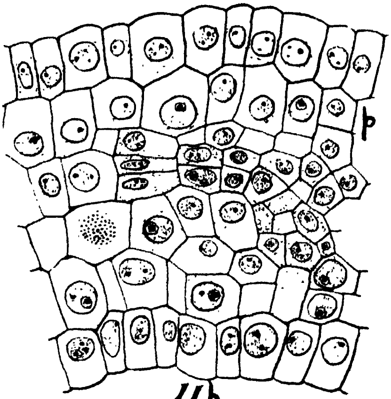

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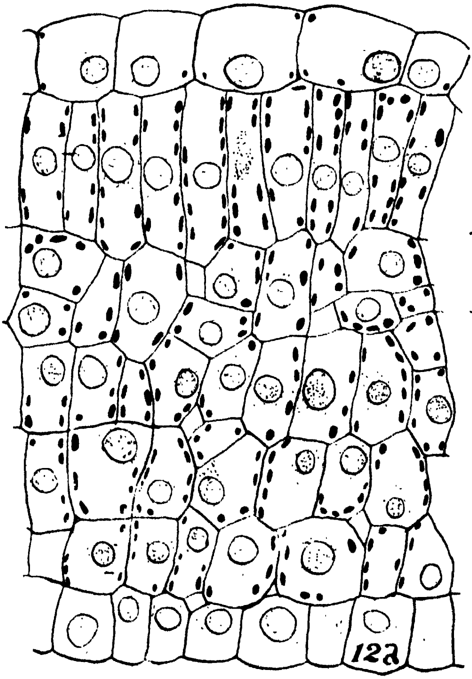

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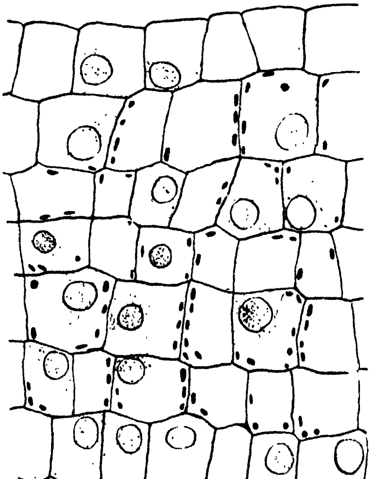

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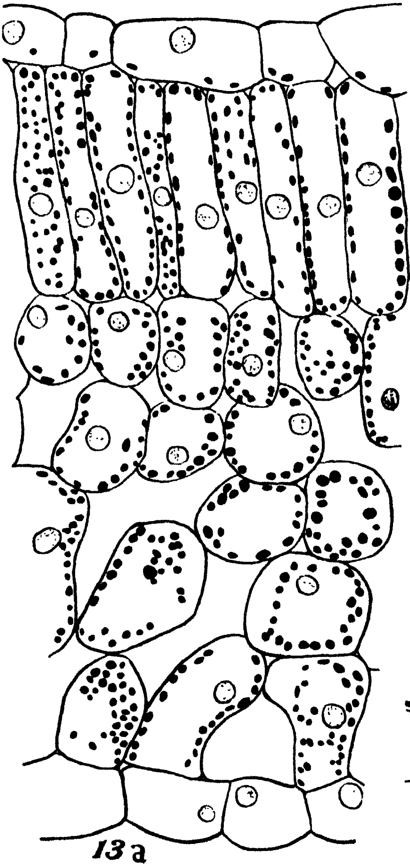

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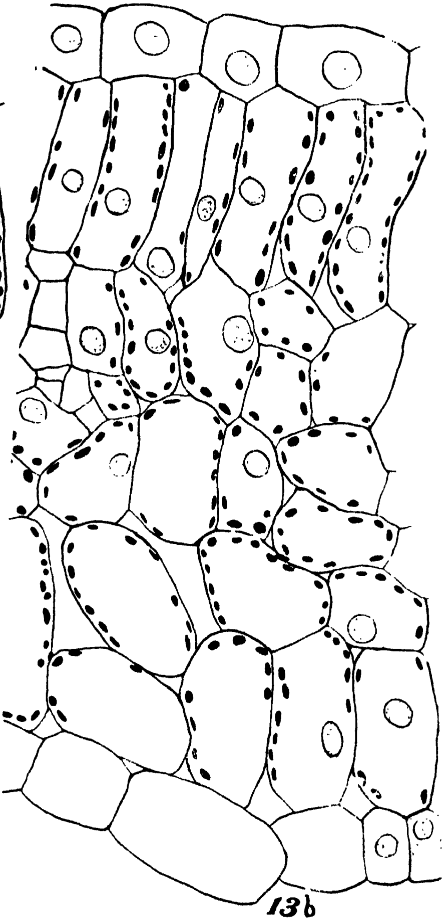

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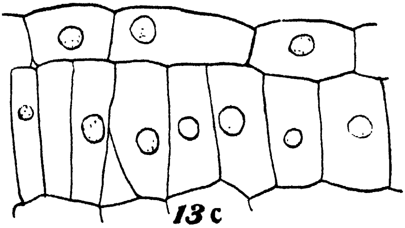

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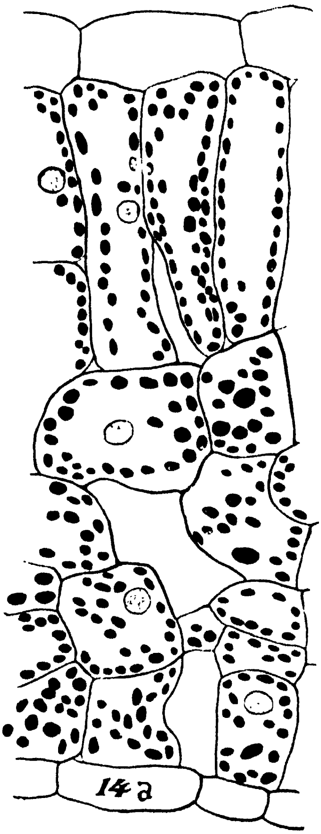

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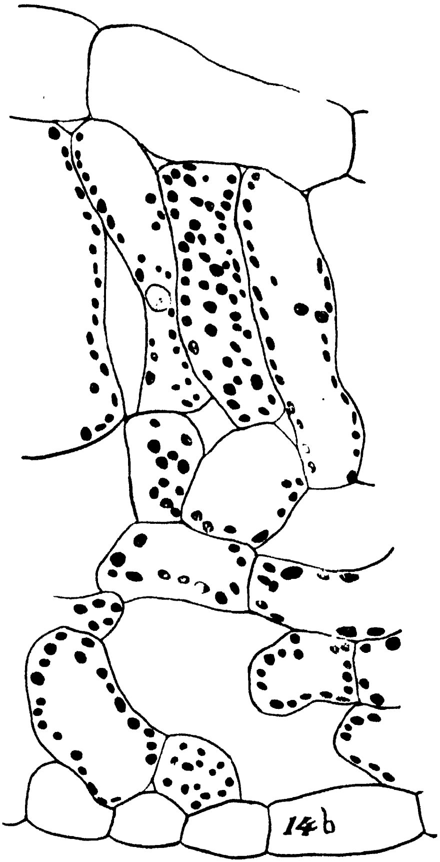

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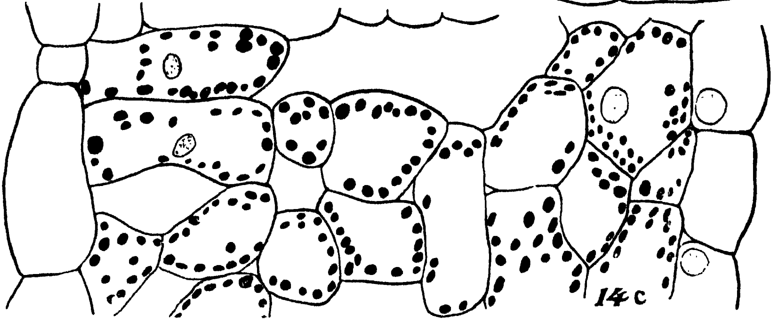

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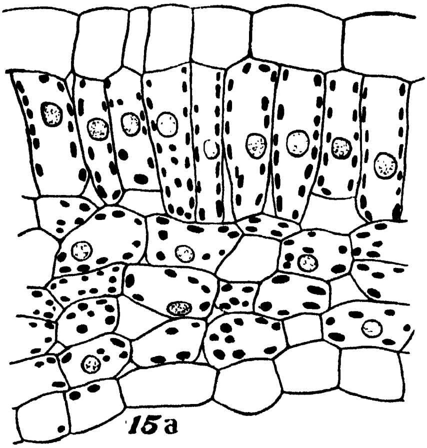
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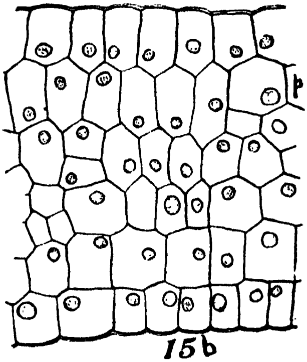

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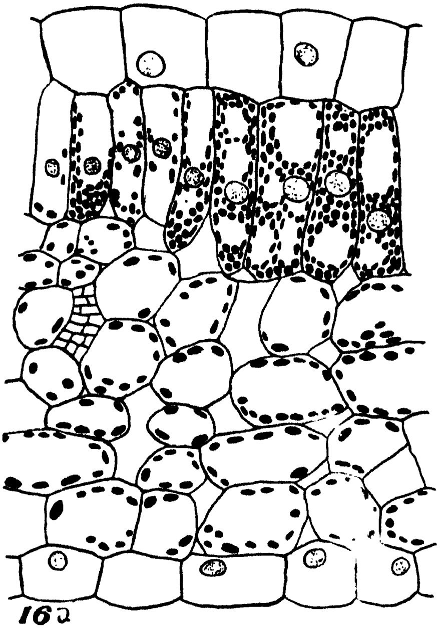
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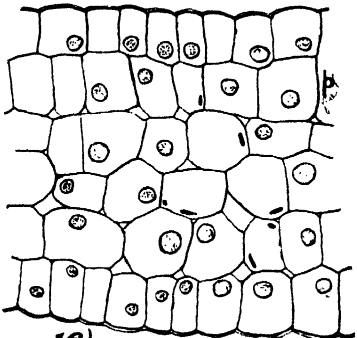

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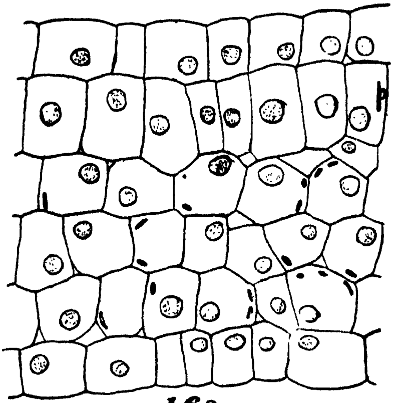

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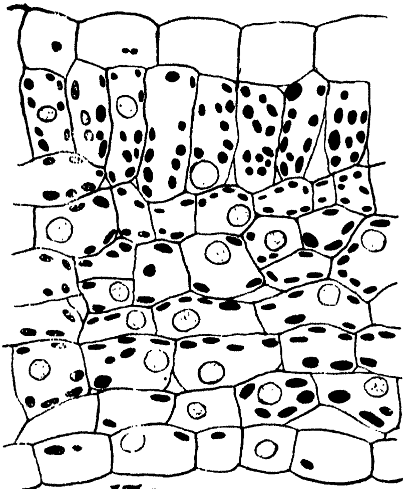

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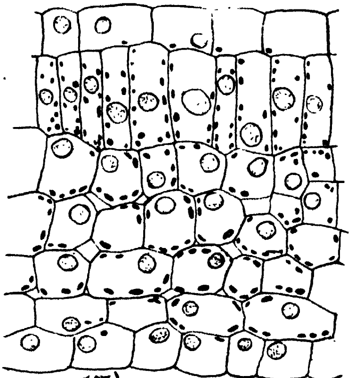

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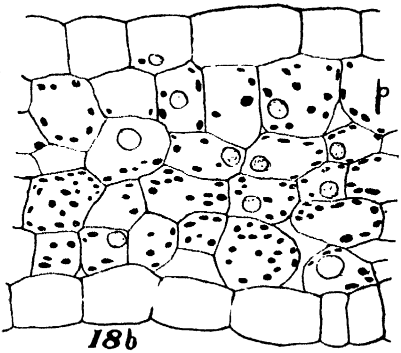

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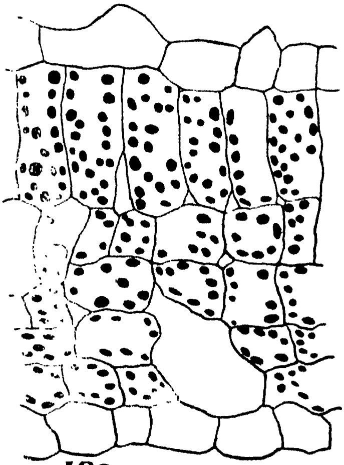

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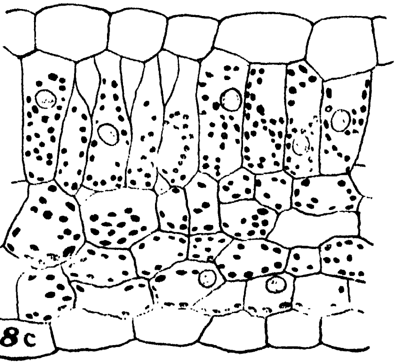

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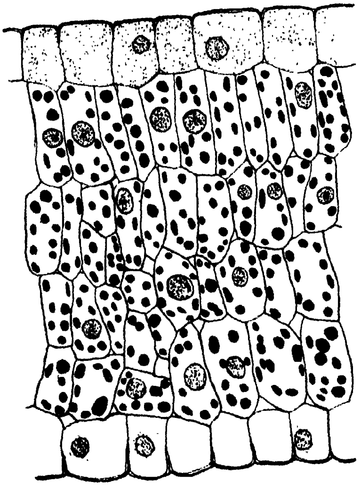

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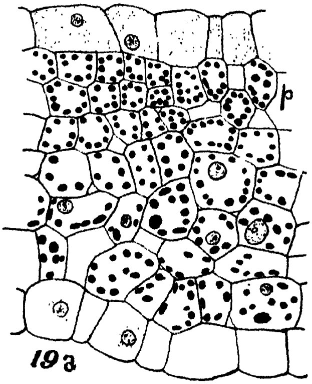

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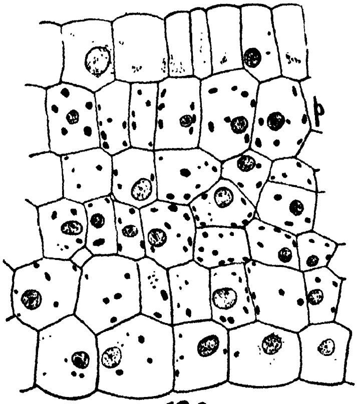

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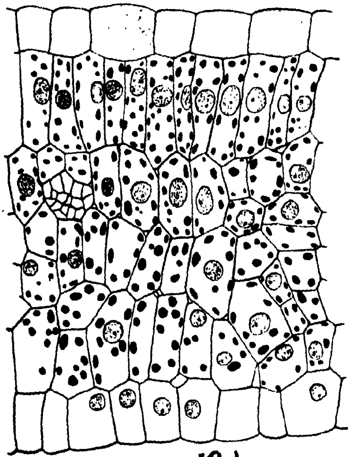

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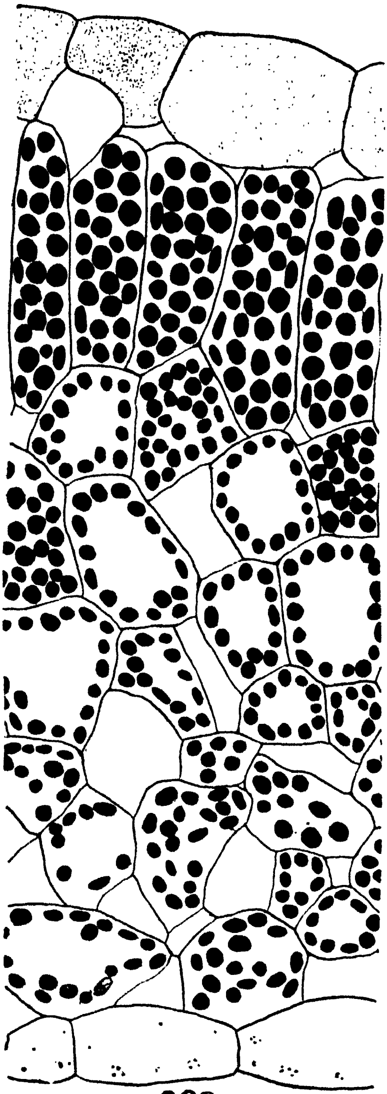

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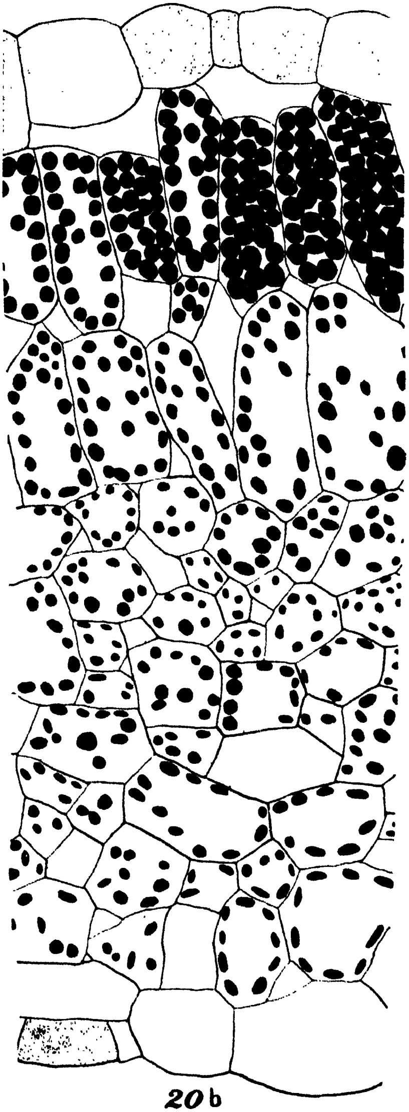

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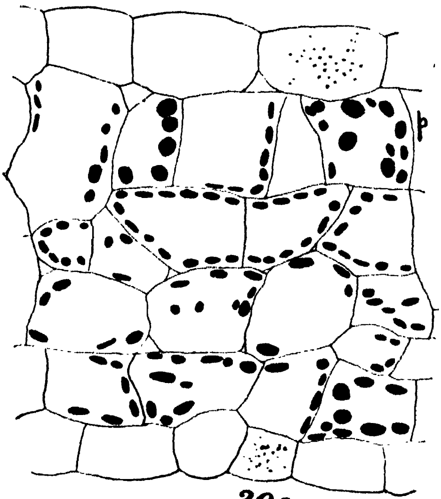
PLATE XIV



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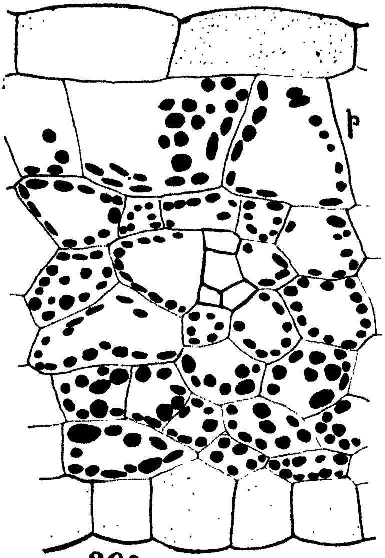

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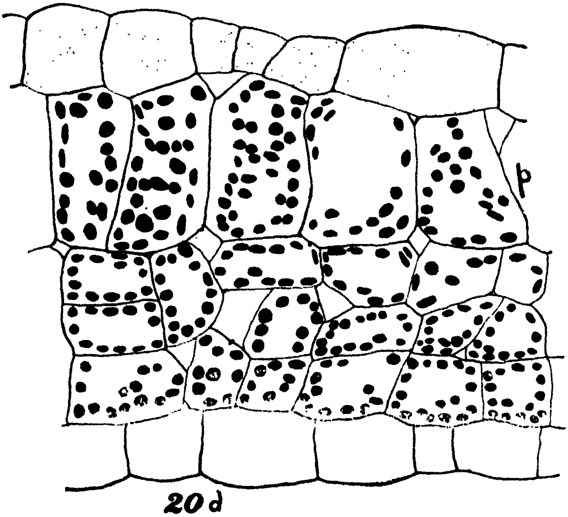

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THE JOURNAL
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MELVILLE T. COOK, Editor.

BIRD RECORDS FROM THE VIRGIN ISLANDS—By *Stuart T. Danforth.*

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BIRD RECORDS FROM THE VIRGIN ISLANDS

By STUART T. DANFORTH
Professor of Zoology and Entomology in the College of Agriculture and Mechanic Arts of the University of Porto Rico at Mayagüez, P. R.

INTRODUCTION

This paper gives the results of several short ornithological excursions which the author made to certain of the British and American Virgin Islands. During these trips the three American Virgin Islands of St. Croix, St. Thomas and St. Jan were visited, and also three of the British islands, namely, Tortola, Salt Island, and Virgin Gorda. A brief description of each of the islands visited may be in order.

DESCRIPTION OF THE ISLANDS

St. Croix is the largest of the Virgin Islands, and occupies a somewhat isolated position considerably south of the other islands of the group. It is twenty-one miles long and five miles wide at its widest point. The island is much flatter than most of the Virgin Islands and much of the land is under cultivation. The land which is not cultivated is largely covered with a dry, brushy type of vegetation which is very prevalent throughout the islands under discussion. There is one good sized hill, Mount Eagle, which reaches a height of 1165 feet. On this hill, and near it at a place called Prosperity, there is still some forest growth which has not been destroyed. Along the coastal region of St. Croix there are a number of salt water lagoons and mangrove swamps which produce the most favorable conditions for shorebirds that I found in any of the islands visited. The largest of these lagoons is Krausse's Lagoon, on the south side of the island. There are no fresh water ponds or swamps on the island. The eastern end of the island is wild and brushy. I arrived on St. Croix on the evening of December 24, 1926, and stayed there until the morning of January 3, 1927.

St. Thomas is the westernmost of the larger islands of the Virgin group. It is twelve miles in length and averages three or four miles in width. It is almost entirely hilly with very little level land. The highest hill is West Mountain, which reaches a height of 1,550 feet. Only a small proportion of the land is under cultivation, and most of it is covered with a dry brushy type of vegetation. Along the coast there are a few indentations where some small mangrove-bordered lagoons exist. Between the only town on the island and its docks there is a cattail swamp perhaps an acre in extent, which is the only fresh water swamp on the island of which I am aware. The time which I spent in St. Thomas was very much broken up consisting mostly of short periods spent there while waiting for transportation to other islands. The following is a list of the days which I spent on St. Thomas: December 24, 1926; January 3–5 and 8–9, and December 17, and 30–31, 1927; January 1 and December 22–23, 1928; and January 3–5, 1929.

St. Jan lies directly east of St. Thomas. It is about eight miles long, and has a very irregular shoreline. It is almost entirely hilly, and has practically no land under cultivation. The highest land is Bordeaux Mountain, which attains an elevation of 1,277 feet. Most of the land on the island is covered with dry brushy vegetation, but on the higher hills larger trees and a less xerophytic type of vegetation are found. Like the British islands which I visited, St. Jan has no roads for wheeled vehicles. I spent two and a half days on St. Jan, from January 6 to 8, 1927.

Tortola is the most important and westernmost of the British Virgin Islands. It lies slightly north and east of St. Jan. It is ten miles long and about three and a half miles wide at its widest point. Its surface is almost entirely hilly, though at places near the coast there are small patches of level land, most of which are under cultivation. Its hills are the highest and most rugged of any in the Virgin Islands. One peak (Mount Sage) reaches a height of 1,780 feet. In some of the stream valleys on the higher hills the most humid type of vegetation which I have seen anywhere in the Virgin Islands can be found; in fact it is practically the only place where fresh water streams which never dry up can be found. Along the coast there are a number of mangrove swamps, but I found no fresh water swamps on the island. I spent the period from December 24, 1928 to January 3, 1929 on Tortola, with the exception of the two days of December 29 and January 1, on which I visited neighboring islands.

Salt Island is a small island directly south of the eastern end of Tortola, lying between Peter Island and Cooper Island. It is an irregular shaped island somewhat over a mile in length, and about the same distance in its greatest width. It is mostly hilly. A hill in the northeast corner of the island is particularly rugged and nearly inaccesible, although it is only about 700 feet in height. South of this hill there are two little level valleys, one of which is occupied by saltponds for the production of salt by the evaporation of sea water. The other is used as grazing land. In the center of the latter valley is a small mudhole which is the nearest approach to a fresh water swamp on the island. The eastern shore of the island slopes off very gradually, leaving extensive shallows. There are some small areas of mangroves on this side of the island. The majority of the island is covered with the brushy xerophytic vegetation so characteristic of the Virgin Islands. I spent only one day (December 29, 1928) on Salt Island, but the island is so small that on that day I covered practically every bit of the island, despite the difficulties and even dangers of traversing certain parts of it (notably the cliffs which one has to negotiate in rounding the hill on the northeast part of the island).

Virgin Gorda, (known to mariners as Spanish Town), is a long, narrow island, and is the easternmost of the group of islands with which we are dealing. It is about ten miles long, but not much over a mile wide in most parts. In reality it consists of two islands joined together, a northern mountainous part culminating in a hill (Virgin Peak, 1,370 feet high), and a low, nearly flat southern part.

The southern part is strewn with large boulders which give it an aspect entirely different from that of any of the other islands of the Virgin group. Back of the beach on the western shore is an extensive brackish water, mangrove bordered lagoon where many ducks and other waterfowl can be found. Under the loose bark of dead mangroves bordering this lagoon I took six examples of *Bufo turpis,* a toad known only from Virgin Gorda, and previously known only from the type specimen taken in 1915 by Mr. J. L. Peters. I spent only one day (January 1, 1929) on Virgin Gorda, so time did not permit me to visit the entire island. Accordingly I confined my attentions to the southern part of the island, making only a short trip at the end of the day into the edge of the mountainous part.

ACKNOWLEDGEMENTS

During the course of my work in the Virgin Islands many persons rendered valuable assistance. Outstanding among them was Dr. J. B. Thompson, Director of the Federal Experiment Station, which occupies Anna's Hope Estate in St. Croix. Dr. Thompson made me his guest during my stay in St. Croix, and furnished me with a Ford

car for use during my work on the island. He has also assisted me very materially in other ways, and I owe a very special debt of gratitude to him. Mr. M. J. Nolan, the Director of Police of St. Thomas, was of special assistance to me in that island. He greatly expedited the issuance of my collecting license, permitting me to begin collecting the minute I landed, and also supplied a Police Department car and chauffeur for use on some of my collecting trips.

So many other persons were of assistance in various ways that it is impossible to mention them all, but I must not neglect to mention my little friend Nelson Biaggi, of Mayagüez, P. R., who accompanied me on my trip to the British Islands. His cheery companionship and assistance in many ways helped very materially in making the expedition more successful than it would otherwise have been.

METHOD OF TREATMENT

In the discussion of birds which follows fifty-eight forms are mentioned, of which I actually collected or observed fifty-six.

In each of the forms covered in this paper the scientific name with the authority is given first, followed by the English name by which the bird is known in published works. In many cases that is followed by the name by which the bird is known locally. However, some birds are so rare as to have no local name, and in other cases I was unable to ascertain any local name. Then a brief general statement about the status of the birds in the Virgin Islands is given, followed by more detailed statements of my observations concerning the birds in each of the islands I visited. Following that is a list of the specimens I collected in the Virgin Islands, giving the number of each specimen in my collection, its sex, and the locality and date where each was collected. The specimens are all in my collection, which is at present deposited at the College of Agriculture and Mechanic Arts of the University of Porto Rico, at Mayagüez, P. R.

The most remarkable feature of the bird life of the Virgin Islands is the rapid dispersal of the Mockingbird through the islands which is at present taking place.

DISCUSSION OF BIRDS

PELECANUS OCCIDENTALIS OCCIDENTALIS Linné. Brown Pelican.
Local Name "Pelican".

The Brown Pelican is found in suitable localities along the coasts of all the islands.

St. Croix: Noted at Frederiksted December 24, 1926 and January 3, 1927 (25); Krausse's Lagoon, December 27 and 31 (25); Christiansted Harbor, December 28; East End, January 1; and Buck Island, January 1.

St. Thomas: A few were noted on every visit to the Island.

St. Jan: Seen at Cruz Bay January 6–8, 1927, and off the north coast on January 3, 1929.

Tortola: Common all along the south coast in December 1928 and January 1929.

Salt Island: Fifteen were seen on December 29, 1928.

Virgin Gorda: Four were seen on January 1, 1929.

SULA LEUCOGASTRA LEUCOGASTRA (Boddaert). Common Booby.

The Booby is generally distributed, but not particularly common throughout the islands.

St. Croix: One was seen at Frederiksted on January 3, 1927.

St. Thomas: One was seen off the south coast on January 5, 1928, and on January 8 one near the east end of the island and another in St. Thomas Harbor.

St. Jan: A few were seen off the west coast on January 7 and 8, 1927, and on January 3, 1929 two in immature plumage were observed off the north coast.

Tortola: Three were seen west of Roadtown on December 25, 1928.

FREGATA MAGNIFICENS Mathews. Man-o-war Bird. Local Name "Hurricane Bird"; in St. Jan; "Weather Bird" in St. Croix.

Although I did not happen to meet this bird in St. Croix, it is well known there, and I found it on a number of the other islands. It doubtless occurs throughout them all.

St. Thomas: One was noted on December 24, 1926, and one on December 22, 1928.

St. Jan: A few were noted off the north and west coasts on January 7 and 8, 1927; and on January 3, 1929 I counted eighteen while sailing along the north coast. Fifteen of these were in one flock.

Tortola: A few were observed at Roadtown and West End on December 26, 1928 and January 3, 1929.

ARDEA HERODIAS ADOXA Oberholser. West Indian Great Blue Heron.

This bird is probably found occasionally on all the islands, although I have definite records from only three.

St. Croix: At Krausse's Lagoon one was recorded on December

27 and two on December 31, 1926. One was seen at Salt River on December 30, 1926, and one at Shoy's Lagoon on January 1, 1927.

St. Thomas: One was noted fishing in shallow water on the south coast on January 4, 1927.

Tortola: One was seen at East End on January 1, 1929.

CASMERODIUS ALBA EGRETTA (Gmelin). Egret.

The Egret is very rare in the Virgin Islands, where it has been recorded only from St. Croix.

St. Croix: Two were noted at Krause's Lagoon on December 31, 1926.

EGRETTA THULA THULA (Molina). Snowy Egret.

The Snowy Egret is rare in the Virgin Islands, where it has previously been reported only from St. Croix.

St. Thomas: One was clearly observed at Bender's Lagoon on January 4, 1927.

HYDRANASSA TRICOLOR RUFICOLLIS (Gosse). Louisiana Heron.

The Louisiana Heron has apparently not previously been recorded from the Virgin Islands, and I have only one record for it.

St. Thomas: One was seen at Bender's Lagoon on January 4, 1927.

FLORIDA CAERULEA CAERULESCENS (Latham). Southern Little Blue Heron.

The Little Blue Heron is one of the commonest and most generally distributed of the herons in the Virgin Islands. It is probably found on them all. I recorded it on all the islands visited except Virgin Gorda.

St. Croix: A few in both blue and white plumages were observed at Salt River, Cane Bay, Krausse's Lagoon and Shoy's Lagoon in December 1926 and January 1927.

St. Thomas: My only record is of three seen at Bender's Lagoon on January 4, 1927.

St. Jan: A few, in both blue and white plumages, were seen at Cruz Bay on January 6 and 8, 1927.

Tortola: Birds in both plumages were fairly common during my stay in December, 1928 and January, 1929. On December 25, 1928 I collected at one shot two birds in the white plumage. The stomach of one contained fourteen small crabs, eight of them fiddler crabs. The stomach of the other had five small *Anolis* lizards and two large red-legged grasshoppers.

Salt Island: One white plumaged bird was seen December 29, 1928 in a small fringe of mangroves.

Specimens collected:

No. 680, male, Roadtown, Tortola, Dec. 25, 1928 (white plumage).

No. 683, female, Roadtown, Tortola, Dec. 25, 1928 (white plumage).

BUTORIDES VIRESCENS MACULATUS (Boddaert). West Indian Green Heron.

The Green Heron is not as common as one would expect to find it in the Virgin Islands. St. Croix was the only island on which I found it at all common.

St. Croix: Fairly common. In December, 1926 and January, 1927 I observed it at Christiansted, Anna's Hope, Krausse's Lagoon, and Shoy's Lagoon. A stomach contained fifteen short-horned grasshoppers; a large long-horned grasshopper (*Neoconocephalus triops*); three small long-horned grasshoppers (*Conocephalus* sp.), and three medium sized spiders.

St. Thomas: Rare. I observed this species only twice, one seen in a small cattail swamp on December 31, 1927, and again on January 1, 1928.

St. Jan: One was observed at Cruz Bay on January 6, and another on January 8, 1927.

Tortola: I recorded the Green Heron three times at Roadtown, (December 25, 26, and 27, 1928).

Specimen collected:

No. 276, male, Anna's Hope, St. Croix, Jan. 1, 1927.

NYCTANASSA VIOLACEA VIOLACEA (Linné). Yellow-crowned Night Heron.

The Yellow-crowned Night Heron has been previously recorded from St. Thomas, St. Croix and Virgin Gorda.

Tortola: On December 26, 1928, I collected a juvenile female apparently scarcely out of the nest, in some mangroves near Roadtown. Its stomach was empty.

Specimen collected:

No. 686, female juv., Roadtown, Tortola, Dec. 26, 1928.

DAFILA BAHAMENSIS BAHAMENSIS (Linné). Bahama Duck.

The Bahama Duck has been previously recorded from St. Thomas. It is very rare in the Virgin Islands.

Virgin Gorda: On January 1, 1929 a pair was observed at close range on the large brackish lagoon in the southern part of Virgin Gorda.

MARILA AFFINIS (Eyton). Lesser Scaup Duck.

The Lesser Scaup Duck has been recorded previously from St. Croix and St. Thomas.

Virgin Gorda: On January 1, 1929 a flock of thirty-five was noted on the large brackish lagoon back of the beach.

BUTEO BOREALIS JAMAICENSIS (Gmelin). West Indian Red-tailed Hawk.

The Red-tailed Hawk has apparently not previously been recorded in life from the Virgin Islands, although bones are known from a kitchen midden in St. Croix.

St. Croix: One was seen at Christiansted on December 28, 1926, and one at Anna's Hope on January 1, 1927. On December 29 I was shown a specimen that had been shot by a planter while attacking his chickens a few days previously.

St. Thomas: One was observed soaring over the hills west of the town on December 30, 1927.

St. Jan: One was observed at Cruz Bay on January 6, 1927, and one in the hilly interior the following day.

Tortola: A pair was seen at Roadtown on December 25, 1928, and again on December 27, and a single bird on December 31. On January 1, 1929 a single bird was noted at East End.

PANDION HALIAËTUS CAROLINENSIS (Gmelin). Osprey. Local name, "Fish Hawk".

The Osprey is a winter visitor in small numbers to the Virgin Islands.

St. Croix: Ospreys were observed on four occasions: Krausse's Lagoon (two on December 27 and one on December 31, 1926); East End (one on January 1, 1927); Anna's Hope (one on January 1, 1927).

Tortola: One was seen at Roadtown Harbor on December 27, 1928.

Salt Island: One was collected on December 29, 1928. Its stomach contained exclusively the remains of fishes.

Specimen collected:

No. 696, male, Salt Island, Dec. 29, 1928.

FALCO PEREGRINUS ANATUM (Bonaparte). Duck Hawk.

The Duck Hawk is a rare winter visitor to the Virgin Islands, where it has previously been recorded from St. Croix and Virgin Gorda.

St. Croix: One was seen at Krausse's Lagoon on December 27, 1926.

Salt Island: One was shot but not recovered on December 29, 1928.

FALCO SPARVERIUS CARIBAEARUM (Gmelin). Antillean Sparrow **Hawk.** Local Name "Killi-killi Hawk".

The Killi-killi Hawk is fairly common on St. Croix, but quite rare on the other islands. Although it has been recorded from St. Thomas and St. Jan I have never observed it on those islands.

St. Croix: Fairly common at Christiansted, Anna's Hope, Southgate and Kingshill in December, 1926, and January, 1927. One stomach contained six caterpillars, a Katydid, fragments of a spider, and two *Gordia* fruits. Another had four *Anolis* lizards, and a cricket (*Gryllus* sp.).

Tortola: During my visit the only example seen was a female which I collected at Roadtown on December 28, 1928. Its stomach contained the tail, fur, and some of the bones of a young rat. The tail of the rat was three and a half inches in length. The stomach also contained two grasshoppers, (*Schistocerca colombina*).

Virgin Gorda: A pair was noted on January 1, 1929.

Specimens collected:

No. 293, female, Anna's Hope, St. Croix, Dec. 27, 1926.
No. 294, female, Anna's Hope, St. Croix, Dec. 31, 1926.
No. 692, female, Roadtown, Tortola, Dec. 28, 1928.

COLINUS VIRGINIANUS VIRGINIANUS (Linné). Quail.

Although I did not personally observe any Quail on my visit to St. Croix, I was told that a few still existed there.

RALLUS LONGIROSTRIS CARIBAEUS Ridgway. Caribbean Clapper Rail.

Clapper Rails have been recorded from St. Thomas and St. Croix, but I found none on those islands.

Tortola: Clapper Rails were common on a small mangrove Island in Roadtown harbor during the time of my visit.

GALLINULA CHLOROPUS PORTORICENSIS Danforth. Antillean Gallinule.

The only one of the Virgin Islands on which I found any Gallinules was Virgin Gorda.

Virgin Gorda: On January 1, 1929 five gallinules were observed and a female collected at the brackish lagoon back of the beach. Its stomach contained algae, small black seeds, and some fine white sand. The specimen agrees well in coloration and measurements with examples in my collection from Porto Rico and Santo Domingo. Therefore I am considering it as belonging to the same race.

I am presenting herewith a tabulation of the measurements of the specimens of Antillean Gallinules now in my collection. The measurements are expressed in millimeters.

	Wing	Tail	Tarsus	Culmen with frontal shield	Width of frontal shield
No. 14, female, P. R, Cartagena Lagoon Apr. 4, 1924.......	174	76	53	45.5	13.5
No. 374, female, P. R., Cartagena Lagoon Mar. 7, 1927....	168.5	80	51	48	15
No. 623, female, P. R., Aguadilla, May 7, 1928............	163	79	55	47.5	15
No. 454 female, R. D., Laguna Salodillo, June 26, 1927....	177	80	55	50	17
No. 544, female, R. D., Laguna Salodillo, June 26, 1927....	168	75	50.5	48	14
No. 706, female, V. I., Virgin Gorda, Jan. 1, 1929..........	165	76	54	45.5	13.5

PAGOLLA WILSONIA WILSONIA (Ord). Wilson's Plover.

The Wilson's Plover has been recorded from several of the Virgin Islands, but I found it only on St. Croix.

St. Croix: Ten were observed at Krausse's Lagoon on December 31, 1926, and six at East End on January 1, 1927. The stomach of a bird collected contained fragments of a centipede.

Specimen collected:

No. 281, male, Krausse's Lagoon, St. Croix, Dec. 31, 1926.

OXYECHUS VOCIFERUS VOCIFERUS (Linné). Killdeer.

Killdeers were found by me only on St. Thomas and Salt Island.

St. Thomas: A number of Killdeers can usually be found, at least in December and January, at the edge of a small cattail swamp between the town and the docks. In my notes I find the following records: December 17, 1927 (flock of six); December 31, 1927 and January 1, 1928 (flock of nine); December 22, 1928 (several); January 4, 1929 (flock of twenty-five, out of which a male was collected.) The stomach of the bird collected contained nine large Tabanid larvae.

Salt Island: On December 29, 1928 a male was collected at a very small mudhole on the east side of the island. It was the only individual of its species seen. Its stomach contained exclusively comminuted insects, mainly Coleoptera, including a Scarabaeid beetle.

The two males from St. Thomas and Salt Island, and a male from St. Martin, are much darker and browner than three males from Porto Rico and Santo Domingo in my collection. Their wings are also longer. Although they come within the limits given by Ridgway for *O.v. rubidus,* I am inclined to regard these birds as *O.v. vociferus,* on account of the darker coloration, and of the fact that they also come within the limits given for *vociferus.* The wing measurements of the specimen's of male Killdeers from the West Indies in my collection follow: They are expressed in millimeters:

	Wings
No. 21, *O.v. rubidus,* P.R., Cartagena Lagoon, Sept. 23, 1924	140
No. 22, *O.v. rubidus,* P.R., Arecibo, Oct. 14, 1926	144.5
No. 410. *O.v. rubidus,* R.D., Haina, June 16, 1927	147
No. 557, *O.v. vociferus,* St. Martin, Great Bay, Dec. 24, 1927	161.5
No. 693, *O.v. vociferus,* Salt Island, Dec. 29, 1928	157
No. 707, *O.v. vociferus,* St. Thoma's, Jan. 4, 1929	159

SQUATAROLA SQUATAROLA CYNOSURAE Thayer and Bangs. American Black-bellied Plover.

The Black-bellied Plover was observed only on St. Croix, where it was found to be common. It has not previously been recorded from the Virgin Islands.

St. Croix: Common. Fifty were observed at Krausse's Lagoon on December 27, 1926, and a hundred on December 31. On January 1, 1927 five were observed at Coakley Bay, and fifty at Southgate. The stomach of a bird collected contained 93 per cent of very small bivalve shells, and 7 per cent of very small snails.

Specimen collected:

No. 280, female, Krausse's Lagoon, St. Croix, Dec. 31, 1926.

ARENARIA INTERPRES MORINELLA (Linné). Ruddy Turnstone.

The Ruddy Turnstone almost undoubtedly occurs at times on all the islands, but I have found it only on St. Croix and Tortola.

St. Croix: Common. More than 150 were seen at Krausse's Lagoon on December 27, 1926, and about 100 on December 31. On January 1, 1927 two were noted at Southgate. The stomach of a bird collected contained fourteen small snails, four earwigs (*Anisolaba maritima*), and a little miscellaneous animal matter.

Tortola: Two were observed at Roadtown on December 25, 1928, and on December 27 one was shot but not recovered.

Specimen collected:

No. 282, male, Krausse's Lagoon, St. Croix, Dec. 31, 1926.

CAPELLA DELICATA (Ord). Wilson's Snipe.

The Wilson's Snipe has been previously recorded from St. Croix, but from none of the other Virgin Islands.

St. Croix: My only record is of one bird seen at Shoy's Lagoon on January 1, 1927.

ACTITIS MACULARIA (Linné). Spotted Sandpiper.

The Spotted Sandpiper is a fairly common and well distributed winter visitor to the Virgin Islands.

St. Croix: One was observed on the sand beach at Prosperity on December 30, 1926, one in a mangrove swamp at Shoy's Lagoon on January 1, 1927, and two on a gravel beach at East End the same day. The stomach of a bird collected was nearly filled with small Crustaceans (sand fleas). It also contained a few insects.

St. Thomas: One was seen at Bender's Lagoon on January 4, 1927, and one near the town on January 5, 1929.

St. Jan: Five were seen in mangrove swamps at Cruz Bay on January 6, 1927, and the same number the following day.

Tortola: One or two were seen at Roadtown on each of the following days: December 25, 26, 27, 28 and 30, 1928.

Virgin Gorda: One was seen at the lagoon on January 1, 1929.

Specimen collected:

No. 279, female, East End, St. Croix, Jan. 1, 1927.

TOTANUS FLAVIPES (Gmelin). Lesser Yellowlegs.

The Lesser Yellowlegs is a fairly common winter visitor to the Virgin Islands.

St. Croix: Twenty-five were observed at Krausse's Lagoon on December 27, 1926, and ten on December 31. On January 1, 1927 ten were seen at Shoy's Lagoon.

St. Thomas: Five were seen at Bender's Lagoon on January 4, 1927.

St. Jan: Five were observed near Cruz Bay on January 6, 1927, and one the following day.

Virgin Gorda: Two were noted at the brackish lagoon on January 1, 1929.

TOTANUS MELANOLEUCUS (Gmelin). Greater Yellowlegs.

Until now, the Greater Yellowlegs has not been recorded from the Virgin Islands.

St. Croix: A few were noted at Krausse's Lagoon on December

27, 1926. The stomach of a bird collected contained four fishes each about an inch in length.

Specimen collected:

No. 277, male, Krausse's Lagoon, St. Croix, Dec. 27, 1926.

PISOBIA MINUTILLA (Vieillot). Least Sandpiper.

The Least Sandpiper was found by me only on St. Croix.

St. Croix: Ten were seen at Krausse's Lagoon on December 31, 1926, and eight at Shoy's Lagoon on January 1, 1927. A stomach had two very small snails, and the wings of two termites. It also contained a large amount of sand.

Specimen collected:

No. 278, male, Krausse's Lagoon, St. Croix, Dec. 21, 1926.

THALASSEUS MAXIMUS MAXIMUS (Boddaert). Royal Tern.

The Royal Tern is fairly common in winter in the Virgin Islands. Probably it visits all the islands at times.

St. Croix: Five were seen at Frederiksted on December 24, 1926, and ten on January 3, 1927. On December 28 one was seen at Christiansted; two at Krausse's Lagoon on December 31, and one at East End on January 1.

St. Thomas: On January 3, 1929 three were seen at the entrance to the harbor.

St. Jan: Three were seen off the west coast on January 8, 1927.

Tortola: A few were observed near Roadtown on December 26, 29, and 31, 1928, and at East End on January 1, 1929.

COLUMBA LEUCOCEPHALA Linné. White-crowned Pigeon.

The White-crowned Pigeon has been recorded from St. Croix and Virgin Gorda, but I found it only on St. Croix.

St. Croix: At Anna's Hope from five to twenty-five of these large pigeons were observed feeding in the cabbage palms on December 26, 28, and 29, 1926, and on January 1 and 2, 1927. One was also observed at Krausse's Lagoon on December 31, and three at Shoy's Lagoon on January 1. The stomach of a bird collected contained five large seeded fruits.

Specimen collected:

No. 283, female, Anna's Hope, St. Croix, Dec. 28, 1926.

COLUMBA SQUAMOSA Bonnaterre. Scaled Pigeon.

The Scaled Pigeon has been previously recorded from St. Croix, St. Thomas, and St. Jan.

St. Croix: One was noted at Prosperity on December 30, 1926.

St. Jan: One was observed in the thick woods in the hilly interior on January 7, 1927.

Tortola: Two were seen in some dense rather dry woods near the summit of one of the higher hills on Tortola on December 26, 1928.

Specimen collected:

No. 685, male, Tortola, Dec. 26, 1928.

ZENAIDA ZENAIDA ZENAIDA (Bonaparte). Zenaida Dove. Local name, "Mountain Dove".

The Zenaida Dove, or Mountain Dove, as it is called locally, was found on all the islands visited.

St. Croix: The Zenaida Dove is astonishingly common and tame in St. Croix. In Porto Rico this species is so shy that on going to St. Croix it seemed hard for me to believe that I was seeing the same species. I find it recorded in my notes from Christiansted, Anna's Hope, St. John Estate, Krausse's Lagoon, Cane Bay, Prosperity, and Salt River. The contents of four stomachs were examined. They contained seeds of many kinds, among which *Cordia* sp., some Crotalaria-like seeds, and some large hooked seeds of the stick-tight type were noted. Gravel to the extent of 12 per cent of the stomach contents was also found.

St. Thomas: Rare. I have recorded the species only once (January 3, 1927).

St. Jan: Fairly common at Cruz Bay during the period of my visit.

Tortola: Observed only once (one at Roadtown on December 28, 1928).

Salt Island: Three were observed on December 29, 1928.

Virgin Gorda: About twenty-five were flushed in some brush and mangroves near the head of the brackish lagoon on January 1, 1929. The stomach of one of these contained the seeds of fruits and a little sand.

Specimens collected:

No. 284, male, St. John Estate, St. Croix, Dec. 25, 1926.
No. 285, female, Anna's Hope, St. Croix, Dec. 28, 1928.
No. 286, male, Anna's Hope, St. Croix, Dec. 29, 1926.
No. 287, male, Cane Bay, St. Croix, Dec. 30, 1926.
No. 700, female, Virgin Gorda, Jan. 1, 1929.

CHAEMEPELIA PASSERINA TROCHILA Bonaparte. Porto Rican Ground Dove. Local Name, "Ground Dove".

The Ground Dove is common in suitable localities on all the islands.

St. Croix: Common practically all over the Island. I find it recorded in my notes as common at Christiansted, Anna's Hope, Prosperity, Salt River, and East End. The stomachs of three birds shot contained exclusively small seeds. The bills of these birds were dusky brown.

St. Thomas: Common. A stomach contained small seeds, including many of the spiny, stick-tight type. It also contained a little sand, amounting to five per cent of the stomach contents. The bill of a bird collected was dusky brown, tinged with rose at the base.

St. Jan: Common. Two stomachs contained small seeds; also sand to the extent of 40 per cent of the contents. The color of the bills of the birds collected was dusky brown, with tinges of dull rose, especially at the base.

Tortola: Fairly common around Roadtown.

Salt Island: About twenty were observed on the day of my visit.

Virgin Gorda: Very common.

Specimens collected:

No. 288, male, Anna's Hope, St. Croix, Dec. 27, 1926.
No. 289, female, Anna's Hope, St. Croix, Dec. 28, 1926.
No. 290, female, Cruz Bay, St. Jan, Jan. 7, 1927.
No. 291, female, Cruz Bay, St. Jan, Jan. 7, 1927.
No. 292, male, St. Thomas, Jan. 8, 1927.
No. 676, male, Roadtown, Tortola, Dec. 25, 1928.
No. 705, female, Virgin Gorda, Jan. 1, 1929.

OREOPELEIA MYSTACEA MYSTACEA (Temminck). Bridled Quail Dove.

St. Croix: One was observed at Prosperity on December 30, 1926.

EUPSITTULA PERTINAX PERTINAX (Linné). Curacao Paroquet.

St. Thomas: On January 4, 1927, I observed a small flock in a thickly grown brushy region east of Bender's Lagoon, in the eastern part of the island. They were so wary and the brush so dense and spiny that I was unable to get within gunshot of them. However it is good to know that the paroquets still exist in St. Thomas, and as the eastern end of the island is largely wild and uncultivated they may continue to exist there for a long time. In the summer from June to August when the guinep fruits are ripe, the paroquets are said to come to these trees in large numbers to feed, and to be much tamer and easier to shoot at that time.

COCCYZUS MINOR TERES Peters. Mangrove Cuckoo. Local Name "Mani Coco".

The Mangrove Cuckoo probably occurs at least occasionally on all the Virgin Islands, but I have recorded it from only three of them.

St. Croix: I did not find the Mangrove Cuckoo common on St. Croix. The only two examples seen were collected. The stomachs contained exclusively Orthoptera and their eggs, (*Microcentrum triangulatum*, 62.5 per cent; *Neoconocephalus triops*, 25 per cent; Locustid eggs, 12.5 per cent).

Tortola: Heard at Roadtown on December 24 and 31, 1928.

Specimens collected:

No. 297, male, Anna's Hope, St. Croix, Dec. 26, 1926.
No. 298, female, Anna's Hope, St. Croix, Dec. 28, 1926.
No. 299, female, Cruz Bay, St. Jan, Jan. 6, 1927.
No. 300 male, Cruz Bay, St. Jan, Jan. 6. 1927.

CROTOPHAGA ANI Linné. Ani. Local Name, "Black Witch".

The Ani is a common bird throughout the Virgin Islands.

St. Croix: Common. Recorded at Christiansted, Anna's Hope, Salt River, and Shoy's Lagoon. A stomach contained a large spider carrying a very large silk case full of young spiders, and a black cricket (*Gryllus* sp).

St. Thomas: Fairly common.

Tortola: Fairly common. A stomach contained three stinkbugs (*Nezara viridula*); one grasshopper (*Plectotettrix* sp); and nine grasshoppers (*Schistocerca colombina*).

Salt Island: Three flocks, with a total of about twenty individuals were noted on the day of my visit.

Virgin Gorda: Common.

Specimens collected:

No. 296, female, Anna's Hope, St. Croix, Dec. 27, 1926.
No. 681, male, Roadtown, Tortola, Dec. 25, 1928.

ORTHORHYNCHUS EXILIS EXILIS (Gmelin). Gilt-crested Hummingbird. Local Name "Doctor Bird".

This beautiful little hummer with its brilliant metallic green crest occurs more or less commonly throughout the Virgin Islands.

St. Croix: Common. Recorded at Christiansted and Anna's

Hope. A stomach contained nothing but small insects, including a small weevil, other small beetles, and some earwigs.

St. Thomas: Fairly common.

St. Jan: Several were seen in the vicinity of Cruz Bay.

Tortola: Common around Roadtown.

Salt Island: Two were seen on December 29, 1928.

Virgin Gorda: Two were seen and one collected on January 1, 1929.

Specimens collected:

No. 301, male, Anna's Hope, St. Croix, Dec. 29, 1926.
No. 302, male, Anna's Hope, St. Croix, Dec. 29, 1926.
No. 303, male, Anna's Hope, St. Croix, Jan. 2, 1927.
No. 304, female, Cruz Bay, St. Jan, Jan. 6, 1927.
No. 305, male, St. Thomas, Jan. 8, 1927.
No. 702, female, Virgin Gorda, Jan. 1, 1929.

SERICOTES HOLOSERICEUS HOLOSERICEUS (Linné). Blue-breasted Hummingbird. Local Name, "Doctor Bird".

This large hummer with the blue breast is common throughout the Virgin Islands.

St. Croix: Common. Recorded at Christiansted, Anna's Hope and East End. Two stomachs contained insects (mainly small beetles), and a few small spiders.

St. Thomas: Fairly common. Seen around the town and at East End.

St. Jan: Common near Cruz Bay.

Tortola: Fairly common around Roadtown.

Salt Island: Two were seen on December 29, 1928.

Virgin Gorda: Four were seen and two collected on January 1, 1929.

Specimens collected:

No. 306, female, Anna's Hope, St. Croix, Dec. 25, 1926.
No. 307, female, Anna's Hope, St. Croix, Dec. 25, 1926.
No. 308, male, Anna's Hope, St. Croix, Dec. 26, 1926.
No. 703, male, Virgin Gorda, Jan. 1, 1929.
No. 704, male, Virgin Gorda, Jan. 1, 1929.

ANTHRACOTHORAX AURULENTUS (Audebert and Vieillot). Porto Rican Mango. Local Name "Doctor Bird".

St. Thomas: Seen on four occasions in December and January.

STREPTOCERYLE ALCYON ALCYON (Linné). **Belted Kingfisher.**

The Kingfisher is a fairly common winter visitor to the Virgin Islands.

St. Croix: Single birds were observed on four occasions (Cane Bay, December 30, 1926; Krausse's Lagoon, December 31, 1926; East End, January 1, 1927, and Southgate, January 1, 1927).

St. Thomas: One was observed at Bender's Lagoon on January 4, 1927.

St. Jan: One was collected in some mangrove swamps near Cruz Bay on January 6, 1927. Its stomach contained a herring-like fish four and a quarter inches long, so large that it could hardly be contained in the stomach.

Tortola: From one to three individuals were seen near Roadtown on each of the days from December 24 to 27, 1928, inclusive.

Specimen collected:

No. 295, male, Cruz Bay, St. Jan, Jan. 6, 1927.

TYRANNUS DOMINICENSIS DOMINICENSIS (Gmelin). **Gray Kingbird.**
Local Names, "Chichiri" and "Chinchiri".

The Gray Kingbird is one of the most abundant resident birds in the Virgin Islands.

St. Croix: Common all over the Island. One stomach contained an assassin bug (*Zelus rubidus*), and fragments of a large Diptera. Another had a flat bug, six large winged black ants, a caterpillar, and some miscellaneous insect fragments.

St. Thomas: Abundant.

St. Jan: Very common. The stomach of a bird collected was nearly empty, and contained only a few comminuted insect fragments.

Tortola: Common. A stomach contained eight adult Lepidoptera and a few lizard bones.

Salt Island: Twelve were observed on December 29, 1928. A stomach contained a Histerid beetle (*Omalodes klugii*), 40 per cent; bones of small *Anolis* lizards, 15 per cent; fragments of Odonata, 20 per cent; Coleopterous fragments 5 per cent; and some small black seeds, 20 per cent.

Virgin Gorda: Ten were observed on January 1, 1929.

Specimens collected:

No. 309, male, Anna's Hope, St. Croix, Dec. 27, 1926.
No. 310, male, Anna's Hope, St. Croix, Jan. 1, 1927.
No. 311, female, Cruz Bay, St. Jan, Jan. 7, 1927.
No. 677, male, Roadtown, Tortola, Dec. 25, 1928.
No. 695, female, Salt Island, Dec. 29, 1928.

ELAENIA MARTINICA RIISII Sclater. Riise's Elaenia. Local Name, "John Phillip".

The Elaenia is a common bird in the Virgin Islands, but I found none on Salt Island or Virgin Gorda. It has not previously been recorded from St. Croix.

St. Croix: I found the Elaenia very common in dry brushy areas. On December 25, 1926 I counted fifteen on a dry brushy hill near Anna's Hope. In addition to this locality I found the species at Cane Bay, Coakley Bay, and Prosperity. The song is a whistled "*Cheery cheery, cheer*". The stomachs of four birds contained 98.75 per cent of vegetable matter (berries and small drupes), and 1.25 per cent of animal matter (small spiders in one stomach).

St. Thomas: Fairly common. A stomach contained a large drupe (85 per cent), and a caterpillar (15 per cent).

St. Jan: Common. A stomach had two large green berries with flat seeds.

Tortola: Fairly common. One was collected in some dry woods on top of a high hill. Its stomach contained one small drupe.

Specimens collected:

No. 318, female, Anna's Hope, St. Croix, Dec. 25, 1926.
No. 319, female, Anna's Hope, St. Croix, Dec. 25, 1926.
No. 320, female, Anna's Hope, St. Croix, Dec. 26, 1926.
No. 321, male, Anna's Hope, St. Croix, Dec. 31, 1926.
No. 322, male, East End, St. Thomas, Jan. 4, 1927.
No. 323, male, Cruz Bay, St. Jan, Jan. 6, 1927.
No. 685, male, Tortola, Dec. 26, 1928.

HIRUNDO ERYTHROGASTER Boddaert. Barn Swallow.

The Barn Swallow has previously been recorded from the Virgin Islands only from St. Croix.

St. Thomas: On December 17, 1927, a flock of fifteen was observed flying over a small cattail marsh between the town and the docks.

MIMUS POLYGLOTTOS ORPHEUS (Linné). Jamaican Mockingbird. Local Name, "Mockingbird".

The Mockingbird was not known from the Virgin Islands until recent years. The first record was of a series collected on St. Thomas in 1916 by R. H. Beck, recorded by Griscom and by Wetmore. Until now this remains the only published record of the species from the Virgin Islands. But more recently the Mockingbird has been spreading through the other islands, and, finding conditions very favorable for its existence, it is increasing very rapidly. The type of brushy country that so abounds in the Virgin Islands is the very type of country where the Mockingbird is most abundant in Porto Rico and other islands where it has long been established.

St. Croix: I was told by residents that Mockers first appeared on the island abount ten years before my visit. During my visit I found a pair at Krausse's Lagoon on December 31, 1926, and collected the female. On January 1, 1927 I observed and collected a singing male at Southgate. One of the stomachs contained a *Cordia* fruit. The other was empty.

St. Thomas: I found the species very common on all of my visits to St. Thomas. Two stomachs contained nothing but berries and drupes.

St. Jan: About half a dozen were noted on each of the days I spent on the island in January, 1927. Two stomachs contained drupes.

Tortola: Not common, but two or three could be observed almost any day. A stomach contained three drupes.

Salt Island: One was observed singing on December 29, 1928.

Virgin Gorda: A singing bird was seen on January 1, 1929.

Specimens collected:

No. 312, female, Krausse's Lagoon, St. Croix, Dec. 31, 1926.
No. 313, male, Southgate, St. Croix, Jan. 1, 1927.
No. 314, male, East End, St. Thomas, Jan. 4, 1927.
No. 315, male, Cruz Bay, St. Jan, Jan. 6, 1927.
No. 316, female, Cruz Bay, St. Jan, Jan. 7, 1927.
No. 684, male, Roadtown, Tortola, Dec. 26, 1928.
No. 688, male, Roadtown, Tortola, Dec. 27, 1928.

MARGAROPS FUSCATUS FUSCATUS (Vieillot). Pearly Eyed Thrasher.
Local Name, "Thrush".

The Pearly Eyed Thrasher is a common resident in the Virgin Islands. It is found most abundantly on brushy hillsides.

St. Croix: A few were observed at Anna's Hope, and the species was found to be common at Prosperity.

St. Thomas: Fairly common.

St. Jan: Very common in the hilly interior, less so near the coast. They were in song at the time of my visit. A stomach was nearly filled with fleshy fruits, but also contained one small beetle.

Tortola: Very common on the wooded brushy hills. A stomach contained eleven red solanaceous berries and two hard black seeds.

Specimens collected:

No. 324, female, Cruz Bay, St. Jan, Jan. 6, 1927.
No. 674, male, Tortola, Dec. 24, 1928.

COEREBA PORTORICENSIS SANCTI-THOMAE (Sundevall). Virgin Island Honey Creeper. Local Name, "Yellow Breast".

In my series of Honey Creepers from the Virgin Islands, except St. Croix, I find that the characteristics given by Wetmore for this subspecies hold true. These characteristics are that the yellow of the underparts is brighter and clearer than that of the Porto Rican birds, and that the flanks are paler.

St. Thomas: Fairly common and generally distributed. On January 1, 1928 one was observed building a nest of wild cotton and fine twigs and roots in the lower branches of a tree about six feet above the ground. At that time the nest was about one quarter completed. The stomach of a bird collected on St. Thomas contained ten small black seeds and some insect fragments.

St. Jan: Common. Three stomachs were examined. One was empty, the second contained a few insect fragments, and the third contained thousands of pollen grains amounting to 40 per cent of contents, and insect fragments amounting to 60 per cent.

Tortola: Common and breeding in December, 1928.

Virgin Gorda: Common in the brushy region around the edges of the large brackish lagoon. Two stomachs had nothing but comminuted insects. A Thrips was recognized in one, and two small Lepidopterous larvae in the other.

Specimens collected:

No. 334, female, East End St. Thomas, Jan. 4, 1927.
No. 335, male, Cruz Bay, St. Jan, Jan. 6, 1927.
No. 336, female, Cruz Bay, St. Jan, Jan. 7, 1927.
No. 337, female, Cruz Bay, St. Jan, Jan. 7, 1927.
No. 672, male, Roadtown, Tortola, Dec. 24, 1928.
No. 679, male imm., Roadtown, Tortola. Dec. 25, 1928.
No. 698, male imm., Virgin Gorda, Jan. 1, 1929.
No. 699, female, Virgin Gorda, Jan. 1, 1929.

COEREBA NEWTONI (Baird). St. Croix Honey Creeper. Local Name, "Yellow Breast".

St. Croix: This Honey Creeper, which is confined to the Island of St. Croix, is very common and generally distributed on that island. During my visit in December, 1926 and January 1927 I observed many nests similar to those of *C. portoricensis* placed at heights of from ten to twenty feet in tamarind and other trees. The iris of the specimens collected was hazel brown. The bill was black, while the fleshy rictus was light pink in color. The legs and feet were mouse gray, the soles of the feet being tinged with yellow. The general appearance, notes and habits of this bird are indistinguishable from those of the Porto Rican species. The contents of five stomachs were examined. Insects formed 90 per cent of the contents, while fine bits of white eggshell in one stomach formed ten per cent of the total contents. Small Lepidopterous larvæ formed 31 per cent; Coleoptera 22, per cent; small Dipteria, 4 per cent; Thysanoptera, 2 per cent; and miscellaneous comminuted insects, 31 per cent.

Specimens collected:

No. 329, male, Anna's Hope, St. Croix, Dec. 26, 1926.
No. 330, male, Anna's Hope, St. Croix, Dec. 29, 1926.
No. 331, male, Anna's Hope, St. Croix, Dec. 30, 1926.
No. 332, male, Anna's Hope, St. Croix, Dec. 31, 1926.
No. 333, female, Anna's Hope, St. Croix, Jan. 2, 1927.

MNIOTILTA VARIA (Linné). Black and White Warbler.

In the Virgin Islands I have found the Black and white Warbler only on St. Croix. However, it has been recorded from St. Thomas, and doubtless occurs on other of the islands as a winter visitor.

St. Croix: Two were seen at Anna's Hope on December 26, two on December 29, 1926, and one on January 2, 1927. One was also noted at Prosperity on December 30, 1926.

Specimen collected:

No. 338, female, Anna's Hope, St. Croix, Dec. 26, 1926.

COMPSOTLHYPIS AMERICANA PUSILLA (Wilson).
Northern Parula Warbler.

The Parula Warbler is probably the most common of the migrant warblers in the Virgin Islands.

St. Croix: One or two individuals were noted at Anna's Hope on December 25, 26, 28 and 29, 1926, and on January 1 and 2, 1927. At Cane Bay one was seen on December 30, 1926. On January 1, 1927 one was observed at Shoy's Lagoon and one at East End. A stomach contained exclusively comminuted insects and their eggs.

St. Thomas: One was noted on each of the following dates: December 24, 1926; December 30 and 31, 1927; January 1 and December 23, 1928.

Tortola: Common near Roadtown from December 24, 1928 to

January 2, 1929. A male and a female were collected, but both were too much damaged to save as specimens.

Specimen collected:

No. 340, sex? Anna's Hope, St. Croix, Dec. 25, 1926.

DENDROICA PETECHIA CRUCIANA Sundevall. Porto Rican Golden Warbler. Local Name, "Canary".

The Golden Warbler is a common resident in the Virgin Islands, frequenting mainly the mangroves, but also occurring in other habitats.

St. Croix: Common. Found most abundantly in the mangroves, but frequently observed in the larger shade trees at some distance from the sea. I find the species recorded in my notes from Anna's Hope, Cane Bay, Salt River, Krausse's Lagoon, and Shoy's Lagoon. Three stomachs contained nothing but comminuted insects, mainly Coleoptera.

St. Thomas: Fairly common. Found in the mangroves, dry brushy regions, and shade trees. A stomach contained 95 per cent of insects (beetles and other); also two spiders amounting to 5 per cent of the contents.

St. Jan: Fairly common in dry brushy places as well as in the mangroves. A stomach contained a spider (50 per cent); insect eggs (15 per cent), and some unidentifiable insect fragments (35 per cent).

Tortola: Common in the mangroves and in the brush growing immediately back of the beaches, but not observed elsewhere. A stomach contained a large Lepidopterous larva *Oxydia* sp. (92 per cent); a very small brown cockroach (4 per cent); an aphid (1 per cent); and some miscellaneous insect fragments (3 per cent).

Specimens collected:

No. 346, female, Anna's Hope, St. Croix, Dec. 27, 1926.
No. 347, male, Krausse's Lagoon, St. Croix, Dec. 27, 1926.
No. 348, male, Shoy's Lagoon, St. Croix, Jan. 1, 1927.
No. 349, male, East End, St. Thomas, Jan. 4, 1927.
No. 350, male, Cruz Bay, St. Jan, Jan. 6, 1927.
No. 678, female, Roadtown, Tortola, Dec. 25, 1928.
No. 687, female, Roadtown, Tortola, Dec. 27, 1928.

DENDROICA DISCOLOR (Vieillot). Prairie Warbler.

The Prairie Warbler is one of the common warblers that visit the Virgin Islands in winter. It occurs mostly in dry brushy regions while in these islands, although a few are occasionally seen in the mangroves.

St. Croix: At Anna's Hope two were observed on December 25, one on December 26, one on December 28. three on December 29, and six on December 31, 1926; and one on January 1 and two on January 2, 1927. Two were also seen at Shoy's Lagoon on January 1, 1927. A stomach contained nothing but insects, mostly beetles, including a small Cocinellid.

St. Thomas: One was seen on December 24, 1926, two on January 3, 1927, one on January 8, 1927, and three on January 1, 1928. A stomach contained only comminuted insects, largely Coleoptera.

St. Jan: Three were observed near Cruz Bay on January 6, and one on January 7, 1927. A stomach had comminuted insects, (beetles and others); also six large insect eggs.

Tortola: One was seen on a high hill on December 24, two in some mangroves on December 25, and two in a dry brushy region on December 26, 1928.

Virgin Gorda: Two were seen on January 1, 1929.

Specimens collected:

No. 351, male, Anna's Hope, St. Croix, Dec. 26, 1926.
No. 352, female, St. Thomas, Jan. 3, 1927.
No. 353, female, Cruz Bay, St. Jan, Jan. 6, 1927.
No. 675, female, Tortola, Dec. 24, 1928.

SEIURUS NOVEBORACENSIS NOVEBORACENSIS (Gmelin). **Water-thrush.**

The Water-thrush is a very common winter visitor to the Virgin Islands, where it is mostly confined to the coastal mangroves and the vicinity of small streams.

St. Croix: Common. Recorded at Anna's Hope, Krausse's Lagoon, Salt River, and Shoy's Lagoon, from December 25, 1926 to January 2, 1927. Two stomachs contained mostly insects, among which Coleoptera figured prominently. A Carabid beetle was recognized in one stomach. Two seeds were found in one stomach, also a small snail.

St. Thomas: One was noted at Benner's Lagoon on January 4, 1927.

St. Jan: Eight were counted in mangrove swamps near Cruz Bay on January 6, 1927. A stomach contained only comminuted insects, among which a small Lygaeid bug and a *Notonecta* sp. were recognized.

Tortola: Common from December 25, 1928 to January 2, 1929. Two stomachs contained nothing but insects, mainly Coleoptera.

Virgin Gorda: Two were observed in the mangroves bordering the brackish lagoon on January 1, 1929.

Specimens collected:

No. 342, female, Salt River, St. Croix, Dec. 25, 1926.
No. 343, female, Anna's Hope, St. Croix, Jan. 2, 1927.
No. 344, male, Cruz Bay, St. Jan, Jan. 6, 1927.
No. 689, male?, Roadtown, Tortola, Dec. 27, 1928.
No. 690, female, Roadtown, Tortola, Dec. 27, 1928.
No. 691, female, Roadtown, Tortola, Dec. 28, 1928.

SEIURUS NOVEBORACENSIS NOTABILIS Ridgway. Grinnell's Water-thrush.

St. Croix: An example was collected at Anna's Hope on December 28, 1926, and is the first record for the island. Its stomach contained five small snails (45 per cent); and insect fragments, mainly Coleoptera, (55 per cent).

Specimen collected:

No. 345, male, Anna's Hope, St. Croix, Dec. 28, 1926.

SEIURUS AUROCAPILLUS AUROCAPILLUS (Linné). Ovenbird.

The Ovenbird doubtless occurs as a winter visitor on most of the Virgin Islands, but I have found it only on St. Croix and Tortola.

St. Croix: One was observed at Anna's Hope on December 28, two on December 29, 1926, and three on January 2, 1927. A stomach contained gravel, 12 per cent; a small snail, 2 per cent; the silky eggcase of a spider, 40 per cent; fragments of insects, 36 per cent, and seeds, 10 per cent.

Tortola: One was observed on a brushy hill above Roadtown on December 24, 1928.

Specimen collected:

No. 341, female, Anna's Hope, St. Croix, Dec. 29, 1926.

SETOPHAGA RUTICILLA (Linné). Redstart.

The Redstart is a fairly common winter visitor to the Virgin Islands.

St. Croix: From one to four individuals were observed at Anna's Hope on December 26, 27, 28, 29 and 31, 1926, and on January 2, 1927. One was seen at Cane Bay on December 30, 1926, and another at Prosperity the same day. A male was shot at Anna's

Hope on January 2, but it was too hopelessly damaged to save as a specimen. The majority of the birds seen were in the female plumage, but a few high-plumaged males were noted.

St. Thomas: A bright plumaged male was collected on January 3, 1927. 95 per cent of its stomach contents consisted of comminuted insects, among which some weevils were noted. Spiders constituted 5 per cent of the stomach contents.

St. Jan: A bird in female plumage was seen in a mangrove swamp near Cruz Bay on January 6, 1927.

Tortola: Two were observed near Roadtown on December 26, and one on December 31, 1928, none of them bright plumaged males. A stomach contained exclusively insects and their eggs, (a fleabeetle, *Cryptocephalus* sp., 10 per cent; two small weevils, 10 per cent; a Lantern Fly, 30 per cent; fifteen insect eggs, 10 per cent; miscellaneous insect fragments, 40 per cent).

Specimens collected:

No. 339, male, St. Thomas, Jan. 3, 1927.

No. 697, male, Tortola, Dec. 31, 1928.

ICTERUS ICTERUS RIDGWAYI (Hartert). Troupial.

St. Thomas: Although I did not succeed in finding the Troupial in St. Thomas, I was universally assured by residents of the island that it is still found commonly there, but that in the winter they are difficult to see, while in the summer they become tamer and come around the houses more freely.

TIARIS BICOLOR OMISSA Jardine. Carib Grassquit. Local Name "Sinbird" in St. Croix; "Sparrow" in St. Thomas and the British Islands.

The Carib Grassquit is a very common resident in the Virgin Islands.

St. Croix: Common resident; recorded at practically every locality visited. Two stomachs were filled with very small seeds.

St. Thomas: Common. On December 31, 1927 an albinistic individual was noted among a flock of eight grassquits. It was of a very light yellowish brown color, nearly white in spots. A stomach contained small seeds, also sand to the extent of 30 per cent of the stomach contents.

St. Jan: Abundant. A stomach contained seeds, also sand (40 per cent).

Tortola: Common. Breeding in December, 1928.

Salt Island: The commonest land bird on the Island.
Virgin Gorda: Common.
Specimens collected:
No. 325, female, Anna's Hope, St. Croix, Dec. 25, 1926.
No. 326, male, Anna's Hope, St. Croix, Dec. 28, 1926.
No. 327, female, Interior of St. Jan, Jan. 7, 1927.
No. 328, male, St. Thomas, Jan. 8, 1927.
No. 673, male, Roadtown, Tortola, Dec. 24, 1928.
No. 694, female, Salt Island, Dec. 29, 1928.
No. 701, male, Virgin Gorda, Jan. 1, 1929.

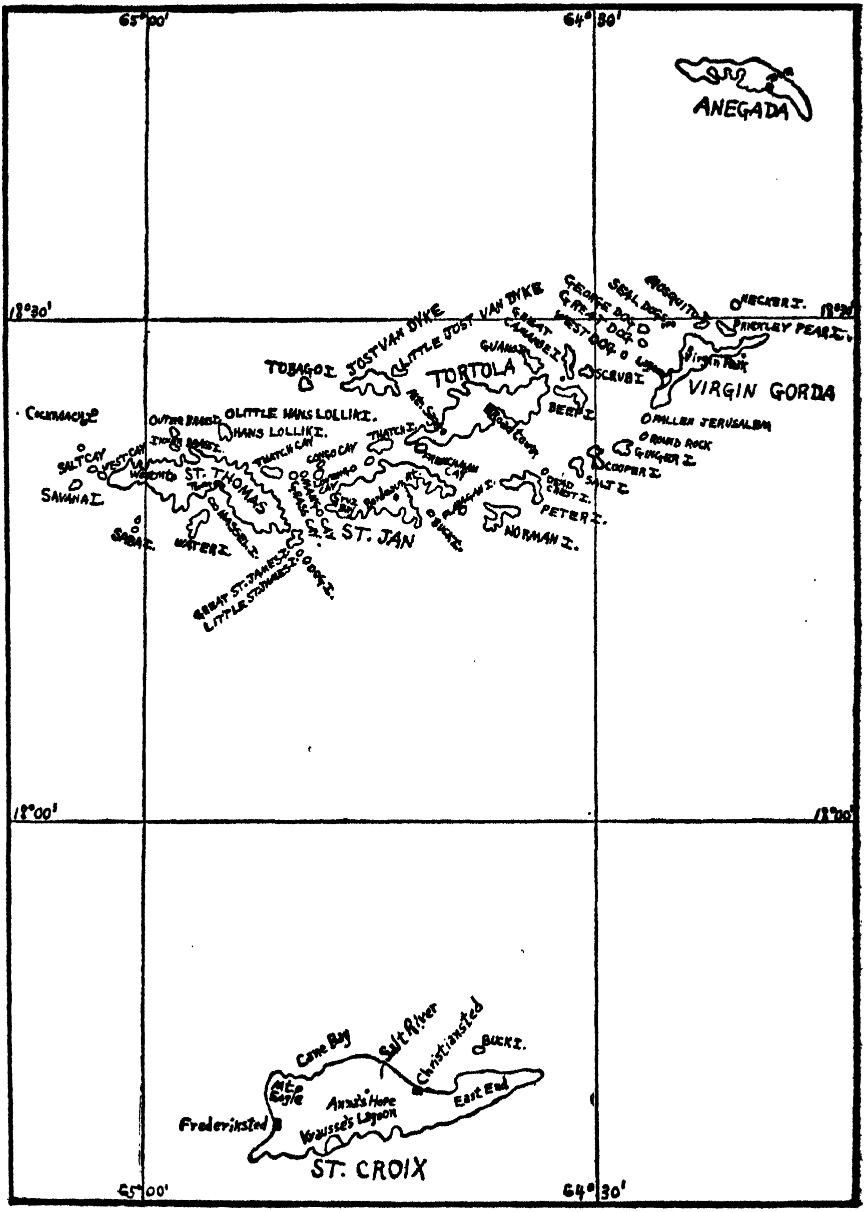

FIG. I.—MAP OF THE VIRGIN ISLANDS
(Adapted from map in Wetmore's "Birds of Porto Rico and the Virgin Islands".)

BIRDS OF ST. CROIX

By Harry A. Beatty,

Estate Constitution Hill, St. Croix, V. I., U. S. A.

[Note: In response to an urgent request, Mr. Beatty has prepared this valuable paper giving the result of his years of study of the birds of St. Croix. Many species are here recorded for the first time from that island, and one (the Canadian Warbler) is new to the known avifauna of the West Indies. While I was in St. Croix I examined the greater part of Mr. Beatty's collections of birds and eggs. I have somewhat revised the original manuscript as given to me by Mr. Beatty by changing the order in which the birds are listed, inserting the scientific names, and making other slight changes of an editorial nature. S. T. Danforth.]

St. Croix, the largest of the American Virgin Islands, is twenty-one miles long, varying in width from one to four and a half miles, and is traversed by a broken range of hills from east to west, attaining its greates height in Mount Eagle, with an altitude of 1,165 feet.

The eastern end of the range is overgrown with brush and cacti, and many of the valleys are now dense jungles. The western portion of the range rises abruptly from the coast line on the north, hence there are many deep valleys clothed in verdant jungles, with an abundance of fruit trees. The south side of the island is mostly flat land, devoted principally to the cultivation of sugar cane.

The ponds include: Kager's, Coakley Bay, South Gate, Rust-op-twist, and Two Williams; the amount of water in them depends on the rainfall and the accumulation off of the hill's, and as there are no running streams to offset the tremendous loss by evaporation they are often dry for many months in the year, which affects the water fowl population. Narrow strips of land, from 100 to 200 feet in width, overgrown with manchineel, sea grape, acacia and nichol vines, separate the ponds, with their fringe of mangroves and brackish water, from the sea.

The mangrove-fringed lagoons, including Krause, the Salt Pond, Billy French, and Hammer Pond, are all separated by narrow strips of land from the sea, with which they are directly connected by two or three small channels.

In conclusion I wish to commend my pal George Seaman, who is now residing on the island, for his friendship and the interest he manifested in the accumulation of data on the birds of St. Croix.

1. *PODILYMBUS PODICEPS ANTILLARUM* (Bangs). Antillean Grebe.

I observed four on October 25, 1922 at Krause Lagoon. George Seaman saw four on December 10, 1923 on Krause Lagoon, and collected one specimen; saw two Jan. 20, 1924, on Two Williams Pond, and collected one.

2. *PELECANUS OCCIDENTALIS OCCIDENTALIS* (Linné). Brown Pelican. Local Name, "Pelican".

Resident. Common. Breeds in February and March on the mainland and Buck Island. March 10, 1924, I collected a set of two eggs, 3.08 × 1.94″; and 3.12 × 1.88″ white chalky shells, nest stained.

3. *FREGATA MAGNIFICENS* (Mathews). Man-o-War Bird. Local Names "Weather Bird" and Hurricane Bird.

Arrives early in February, and remains until July. I have never found them nesting, although they are found in large numbers on Buck Island.

4. *ARDEA HERODIAS ADOXA* (Oberholser). West Indian Great Blue Heron. Local Name, "Blue Gaulin".

Uncommon. Usually seen on the open pastures around Krause Lagoon and on the sea coast, in the shallows. Although I am certain that they nest on the island I have been unable to locate nests or young birds.

5. *CASMERODIUS ALBUS EGRETTA* (Gmelin). Egret. Local Name, "White Gaulin".

Uncommon. After many years of persistent searching my efforts were finally rewarded on March 30, 1924, when I found the nesting site of the colony. Along with other species, there were two nests of this species situated near the top of a large clump of mangroves which grew far out in the least inviting part of Krause Lagoon. One nest was empty, and the other contained two downy white chicks and one addled egg, which I handled very carefully, and is now in my collection. It measures 2.22 × 1.63″, and is pale greenish blue in color.

6. *EGRETTA THULA THULA* (Molina). Snowy Egret. Local Name, "White Gaulin".

Resident, and increasing in numbers; at present not uncommon. I collected two sets of eggs on March 30, 1924; one set of three, 1.75 × 1.28″, 1.75 × 1.28″, 1.72 × 1.31″; one set of two eggs, 1.59 × 1.25″ and 1.69 × 1.25″. Nests in colony at Krause Lagoon, of coarse sticks loosely put together to form a platform. Eggs pale greenish blue.

7. *FLORIDA CAERULEA CAERULESCENS* (Latham). Southern Little Blue Heron. Local Name "Blue Gaulin".

Resident, and increasing in numbers; at present not uncommon. Found them breeding in colony at Krause Lagoon with other species. A set of three eggs collected March 30, 1924, were greenish blue, 1.75 × 1.31″, 1.75 × 1.31″, and 1.78 × 1.38″. Nest a frail platform of coarse sticks.

8. *BUTORIDES VIRESCENS MACULATUS* (Boddaert). West Indian Little Green Heron. Local Name, "Least Pond Gaulin".

Resident. Very common. I have found nests in almost every month of the year. I collected a set of three eggs August 4, 1919, 1.50 × 1.13″, 1.50 × 1.13″, and 1.59 × 1.13″, pale greenish in color; nest a frail platform of coarse sticks placed twenty-five feet up on the horizontal branch of a mahogany tree on Constitution Hill, far from water.

9. *NYCTICORAX NYCTICORAX NAEVIUS* (Boddaert). Black Crowned Night Heron.

March 20, 1922, I shot a male on South Gate Pond.

10. *NYCTANASSA VIOLACEA VIOLACEA* (Linné). Yellow Crowned Night Heron. Local "Night Gaulin".

Resident; a very common species. A set of three eggs taken May 4, 1922, was greenish blue in color, and measured 2.16 × 1.50″, 2.16 × 1.50″, and 2.03 × 1.47″; nest a bulky platform of coarse sticks stituated in a mahogany sapling, seven feet above the ground.

11. *DENDROCYGNA ARBOREA* (Linné). West Indian Tree Duck.

Resident. Now very rare on the island, where fifteen years ago it was very common, and used to breed.

12. *DENDROCYGNA AUTUMNALIS* (Linné). Black-bellied Tree Duck.

I collected a male May 18, 1919, on South Gate Pond.

13. *MARECA AMERICANA* (Gmelin). Baldpate.

George Seaman shot a male Nov. 11, 1921, on Krause Lagoon.

14. *ANAS BOSCHAS BOSCHAS* (Linné). **Mallard.**

Shot a male in perfect plumage March 14, 1919, on Southgate Pond.

15. *DAFILA ACUTA TZITZIHOA* (Vieillot). **Pintail.**

Collected a male and female Nov. 5, 1921, on Krause Lagoon.

16. *DAFILA BAHAMENSIS BAHAMENSIS* (Linné). **Bahama Duck.** Local Name, "Brass Wing Teal".

Resident, not common. In March and April I have seen ducklings of this species on South Gate Pond. No nests or eggs were found by me.

17. *QUEREQUEDULA DISCORS* (Linné). **Blue Winged Teal.**

Observed ten on Oct. 5, 1921, and eight on Nov. 24, 1922, on South Gate Pond, and collected four specimens; also ten on January 5, 1923, and thirty on Feb. 10, 1924, on Krause Lagoon, and collected three specimens.

18. *ERISMATURA JAMAICENSIS JAMAICENSIS* (Gmelin). **West Indian Ruddy Duck.**

Collected four specimens from a flock of ten Oct. 5, 1922, on South Gate Pond.

19. *BUTEO BOREALIS JAMAICENSES* (Gmelin). West Indian Red-tailed. Local Name, "Chicken Hawk".

Resident. A few found in isolated pairs over the island, and they seem to maintain their numbers well from year to year considering that many of them are shot. I located a nest on March 3, 1922, constructed of coarse sticks, bulky, with a depression in the center. The two dull white eggs measured 2.22 × 1.38″, and were nest stained brownish. The nest was situated about seventy-five feet up at the top of a "water wood" tree that grew in a heavily wooded locality bear Constitution Hill. February 17, 1924, I examined another nest which was composed of coarse sticks and placed fifty feet up in the crotch of a limb on a mahogany tree near estate La Grange; the two fresh dull white eggs, slightly nest-stained each measured 2.28 × 1.38″. Both sets are in my collection.

20. *PANDION HALIAËTUS CAROLINENSIS* (Gmelin). **Osprey.**

Regular winter visitant, not uncommon. May 6 (2); August 13 (2); November 27 (2); March 23 (2); April 9 (2); September 24 (2). Specimens collected.

21. *FALCO COLUMBARIUS COLUMBARIUS* (Linné). **Pigeon Hawk.**

Regular winter visitant. Nov. 5 (4); Nov. 26 (1), near Krause Lagoon. Feb. 23 (1); Jan. 1 (1), at Estate La Grange. Two specimens collected.

22. *FALCO SPARVERIUS CARIBAEARUM* (Gmelin). **Antillean Sparrow Hawk. Local Name "Killy-killy".**

Resident. Very common, and found on all parts of the island. Nest in holes in trees; breed from February to May. Collected a set of three fresh eggs May 28, 1919 that were resting on the bare wood at the bottom of a hole two feet deep, in a "Thibet" tree on Estate Constitution Hill. The eggs measured 1.44 × 1.16″; 1.44 × 1.16″; 1.41 × 1.16″; they were straw brown in color very evenly peppered with chocolate and brown specks.

23. *COLINUS VIRGINIANUS VIRGINIANUS* (Linné). **Quail. Local Names "Quail" and "Quail-dle".**

Resident. Rapidly decreasing in numbers, and now their range is restricted to the cattle pastures of the south side of the island. I collected a set of ten eggs May 11, 1924, on Estate "Envy".

24. *RALLUS LONGIROSTRIS CARIBAEUS* (Ridgway). **Caribbean Clapper Rail.**

Resident. Common in the mangroves bordering Krause Lagoon, the only place on the island where they are found. Aug. 27, 1919, I flushed a bird from her nest, hidden in a bed of tall "pond weeds" that grow on the elevations above the water's level. The nest was composed of "pond weeds" placed six inches above the ground. The set of seven eggs, which I collected, measured as follows: 1.75 × 1.19″; 1.75 × 1.19″; 1.72 × 1.19″; 1.72 × 1.19″; 1.69 × 1.19″; 1.75 × 1.19″ 1.72 × 1.16″; glossy cream white color with large blackish and dark spots.

25. *PORZANA CAROLINA* (Linné). **Sora.**

A regular winter visitant; common on all the ponds, and Krause Lagoon. Jan. 5, 1922, I saw 20 on South Gate Pond; Oct. 22, 1922, 30 on Two Williams Pond; Dec. 10, 1922, 25 on South Gate Pond; Feb. 5, 1923, 25 on Krause Lagoon; Mar. 20, 1923, 25 on Krause Lagoon. Many specimens were collected.

26. *GALLINULA CHLOROPUS PORTORICENSIS* (Danforth). **Antillean Gallinule. Local Name "Waterfowl".**

Not an abundant species, but found on all the ponds and lagoons.

Breeds from March to July. A set of six eggs taken July 22, 1919, measured as follows: Four eggs, 1.81 × 1.31″; two eggs, 1.79 × 1.31″. A single rotten egg taken from another nest measured 1.75 × 1.28″. Nest made of "rushes", shaped into a platform, deeply cupped, and placed two feet above the water among the growing "rushes". Eggs glossed creamy white with large and small brown and light brown spots.

27. *FULICA AMERICANA GRENADENSIS* (Riley). **West Indian Coot.**

Common on all the ponds and lagoons, where they breed from July to October. Aug. 10, 1919, I took seven eggs from a nest which was composed of coarse sticks forming a platform on a mangrove branch extended on the surface of the water on South Gate Pond. Eggs measured as follows: 4 eggs, 1.94 ×1.31″; 3 eggs 1.97 ×1.31″; dull white with a dusky tint and sprinkled with blackish. (Note: In a letter Mr. Beatty especially calls my attention to the fact that he has never found *F. caribaea* on St. Croix, S. T. D.)

28. *CHARADRIUS NIVOSUS TENUIROSTRIS* (Lawrence). **Cuban Snowy Plover.**

Migrant. Arrives in April and leaves in September. Occurs in lesser numbers than the Wilson's Plover. I collected three eggs May 25, 1921, 1.50 × 1.00″; 1.48 × 1.00″; 1.48 ×1. 00″, creamy white ground color spotted and scrawled with brown and light brown. Nest a depression in the sand, unlined, among weeds.

29. *CHARADRIUS SEMIPALMATUS* (Bonaparte). **Semipalmated Plover.**

Irregular transient visitor. Krause Lagoon, Nov. 11 (6); Sept. 1 (6). Specimens collected.

30. *OCTHODROMUS WILSONIUS WILSONIUS* (Ord). **Wilson's Plover.**

Summer resident. Occurs in small numbers on Krause Lagoon, Hammer Pond, and Salt Pond, where they nest on the sandy stretches, depositing their eggs, usually three, in a depression in the sand, sometimes lined with bits of broken shells. Arrive in January, and leave in October. Three eggs taken May 15, 1922, measure 1.50 × 1.08″; 1.50 × 1.08″; and 1.44 × 1.08″, buffy white, spotted and scrawled with brown, light brown, and dusky.

31. *OXYECHUS VOCIFERUS VOCIFERUS* (Linné). **Killdeer.**

Jan. 7, 1922 (12); Feb. 15, 1922 (10); in ploughed field on La Grange Estate on both occasions. Three collected.

32. *PLUVIALIS DOMINICUS DOMINICUS* (Muller). Golden Plover.

Shot a male out of three observed at Krause Lagoon, Dec. 29, 1921.

33. *SQUATAROLA SQUATAROLA CYNOSURAE* (Thayer & Bangs). Black-bellied Plover.

Shot a male out of three seen May 6, 1922. A specimen was collected by George Seaman.

34. *ARENARIA INTERPRES MORINELLA* (Linné). Ruddy Turnstone.

Regular transient visitor. Observations, Aug. 15 (12); Aug. 13 (20); Nov. 11 (6); Nov. 26 (12); Nov. 29 (50); Jan. 8 (6); Mar. 23 (6); April 14 (12); May 6 (6); May 31 (10). Frequent the seacoast, Krause Lagoon, and Saltpond. Several specimens collected.

35. *GALLINAGO DELICATA* (Ord). Wilson's Snipe.

Regular transient visitor. Sept. 2 (3); Nov. 26 (40); Mar. 10 (30); Oct. 22 (1); Jan. 1 (25), all at Krause Lagoon. Several specimens collected.

36. *PHAEOPUS HUDSONICUS* (Latham). Hudsonian Curlew.

Shot a female out of a pair Aug. 13, 1922, at Krause Lagoon.

37. *ACTITIS MACULARIA* (Linné). Spotted Sandpiper.

Regular transient visitor. Krause Lagoon, Aug. 13 (1); Jan. 8 (4); Sept. 1 (5); Jan. 1 (8). Specimens collected.

38. *TRINGA SOLITARIA SOLITARIA* (Wilson). Solitary Sandpiper.

Shot a pair on Coakley Bay Pond, Sept. 20, 1919.

39. *CATOPTROPHORUS SEMIPALMATUS SEMIPALMATUS* (Gmelin). Willet.

Regular transient visitant. Observations, Sept. 1 (12); Nov. 26 (20); Nov. 29 (about 100); Dec. 29 (24); Feb. 10 (10); Apr. 6 (4); May 6 (4); May 22 (6); May 31 (1), Krause Lagoon. Specimens collected.

40. *TOTANUS FLAVIPES* (Gmelin). Lesser Yellowlegs.

Regular transient visitant. Observations, Krause Lagoon, Aug. 13 (4); Sept. 5 (24); Oct. 1 (20); Nov. 24 (20); Nov. 29 (60); Dec. 29 (15); Mar. 20 (5); May 1 (3); June 1 (50); June 12 (6). Specimens collected.

41. *TOTANUS MELANOLEUCUS* (Gmelin). **Greater Yellowlegs.**

Uncommon transient visitant. Observations, Krause Lagoon, Sept. 4 (25); Oct. 22 (4); Nov. 26 (2). Specimens collected.

42. *PISOBIA MINUTILLA* (Vieillot). **Least Sandpiper.**

Regular transient visitor. Observations, July 25 (2); Aug. 13 (50); Sept. 5 (24); Sept. 10 (about 100); Nov. 29 (about 100); Dec. 29 (30); Mar. 23 (15); May 6 (about 100). Many specimens collected.

43. *PISOBIA MELANOTOS* (Vieillot). **Pectoral Sandpiper.**

Oct. 1 (12); Nov. 2 on pasture land after heavy rains, near Two Williams Pond. Four specimens collected.

44. *LIMNODROMUS GRISEUS GRISEUS* (Gmelin). **Dowitcher.**

Collected two specimens from a flock of ten, Dec. 11, 1921, Krause Lagoon.

45. *EREUNETES PUSILLUS* (Linné). **Semipalmated Sandpiper.**

Regular transient visitor. Observations, Sept. 1 (25); Sept. 10 (50); Nov. 24 (10); Nov. 29 (about 100); Dec. 29 (30); Jan. 8 (2); Mar. 23 (10). Frequents the same places as the Least Sandpipers, and often found in the same flocks.

46. *LIMOSA FEDOA* (Linné). **Marbled Godwit.**

Shot a female out of a pair, Nov. 11, 1921, at Krause Lagoon.

47. *TRINGA CANUTUS* (Linné). **Knot.**

Shot a male on Krause Lagoon, Dec. 11, 1921.

48. *HIMANTOPUS MEXICANUS* (Müller) **Black Necked Stilt. Local Name, "Red-Shank".**

Small numbers were found nesting in May and June on Krause Lagoon and Rust-op-twist Pond. Arriving in March they raise their brood, and depart in September. I collected three eggs June 14, 1921. Nest a hollow in the sand, four feet from the water's edge scantily lined with broken pieces of sticks. Eggs measured 1.72 × 1.16"; 1.72 × 1.16"; and 1.74 × 1.16"; buffy clay color heavily spotted with dusky and blackish brown.

49. *LARUS ATRICILLA ATRICILLA* (Linné). **Laughing Gull. Local Names, "Sea-gull", and "Booby".**

Arrive about April in small numbers, and stay until the early part of September. A few birds apparently breed on Krause Lagoon. I observed immature birds in August, but found no nests with eggs.

50. *STERNA DOUGALLII DOUGALLII* (Montagu). **Roseate Tern.** Local Name, "Sea-gull".

Occurs in small numbers, rarely in cocks of from six to ten birds, from March to October. I observed immature birds in August on Krause Lagoon. They also breed on Bank Island. No eggs collected.

51. *STERNA FUSCATA FUSCATA* (Linné). **Sooty Tern.**

I shot a male on the rocks at Hams Bluff, March 20, 1924.

52. *STERNA ALBIFRONS ANTILLARUM* (Lesson). **Least Tern. Local** Name "Sea-swallow".

Arrive in April and depart in September. A colony of about 150 birds breeds on the sandy flats of Krause Lagoon and another of about the same size at the Salt Pond. I collected a set of two eggs June 20, 1919, both the same size 1.28 × .94″; grayish white with large blackish spots. Nest a depression in the sand, unlined.

53. *THALASSEUS MAXIMUS MAXIMUS* (Boddaert). **Royal Tern.**

Regular visitant. March 5 (3); May 22 (3); Sept. 1 (2); Sept. 20 (8); Sept. 24 (4); Oct. 1 (50); Oct. 6 (6); Nov. 22 (10); Nov. 27 (3); Feb. 10 (2). No nesting records. Specimens collected.

54. *COLUMBA LEUCOCEPHALA* (Linné). **White Crowned Pigeon. Local** Names, "Blue Pigeon", and "White-head".

Arriving in March they scatter over the island to feed until May and June, when they gather in countless numbers on Green Quay islet to breed. They build their frail nests of sticks so close together that it is impossible to take a step for fear of destroying eggs and Young. A set of two glossy white eggs measured 1.44 × 1.09″; 1.50 × 1.09″; taken June 21, 1921. A few birds always stay on the island, keeping to the heavy woods of the North Side.

55. *COLUMBA SQUAMOSA* (Bonnaterre). **Scaled Pigeon. Local Names,** "Blue Pigeon", and "Red-head".

Resident. Occurs in small numbers. Confined chiefly to the North Side woods. Breeds in July and August. A nest found July 25, 1921, was a very frail platform of coarse sticks, situated twenty-five feet up on the forked branch of a mahogany tree. I could see plainly the two glossy white eggs through the nest from below. Eggs measured 1.50 × 1.03″; 1.47 × 1.03″. It is not unusual to find nests with only one egg or chick.

56. *ZENAIDA ZENAIDA ZENAIDA* (Bonaparte). Zenaida Dove. Local Name, "Mountain Dove".

Resident in large numbers, but during May and June greater numbers of birds come to Green Quay islet to breed, nesting in company with the White-crowned Pigeons, and leave in July. Resident birds breed on the mainland.. On May 5, 1919, a set of two glossy white eggs, 1.28 × .97″ and 1.25 × .97″, was taken on Estate Constitution Hill. The nest is a platform of sticks, usually better constructed than that of the White Crowned Pigeons.

57. *CHAEMEPELIA PASSERINA TROCHILA* (Bonaparte). Porto Rican Ground Dove. Local Name, "Ground Dove".

Resident. Occurs in large numbers on all parts of the island. Breeds in May and June. A nest of fine sticks, unlined, with two glossy white eggs, .84 × .66″, and .88 × .66″, was found June 14, 1921, situated four feet above the ground on the branch of an acacia.

58. *OREOPELEIA MYSTACEA MYSTACEA* (Temminck). Bridled Quail Dove. Local Names, "Partridge", and "Wood Dove".

Resident. Once a common bird in the heavy woods of the North Side, but now close to extinction. Sept. 10, 1923, I shot an immature bird which had not been long out of the nest, as the soft bill, broad at the base, indicated, and I believe it flushed from a nest as I forced my way through the heavy underbrush. The mongoose is solely responsible for the decrease in the numbers of this species.

59. *COCCYZUS MINOR TERES* (Peters). Mangrove Cuckoo. Local Names, "Cat Bird" and "Cow Bird".

An abundant species, having a general distribution. Their nests are difficult to locate. A set of two pale sky blue eggs collected Feb. 10, 1922, measured 1.25 × .94″; and 1.19 × .94″. I waited ten days before taking these eggs to give the female time to deposit others, but apparently this was the full complement. The nest was a bulky platform of coarse sticks placed eight feet above the ground on the horizontal branch of a "ginger thomas" tree.

60. *CROTOPHAGA ANI* (Linné). Ani. Local Name, "Black Witch".

Resident. Common on all parts of the island except the heavily wooded areas. It's breeding habits are irregular. A set of seven eggs was collected Nov. 17, 1921 from a nest occupied by a single pair of birds. The nest was well constructed of coarse sticks, having a deep, unlined cavity. The eggs were greenish blue in color, with a white chalky coating, scratched in several places.

61. *GYMNASIO NUDIPES NEWTONI* (Lawrence). Newton's Owl. Local Name, "Kookoo bird".

Newton's Owl. Local name, "Kookoo bird". I have come to the conclusion that this species is now extinct on the island, after years of fruitless efforts on my part to obtain, or even hear, a single specimen. Thirty years ago it must have been a fairly common bird in its restricted area, the heavily wooded areas of the North Side. All the native "old-timers" who have been living in that vicinity all their lives are familiar with the little "kookoo-bird", as it is known to them. In 1923 I was taken to a very old "thibet tree" which was nothing more than a living shell. About twenty feet up there was a large hole in the side. Pointing at the hole, the aged cattle herder, who is still alive and living in the "village" at Little Fountain Estate, where he was born, said to me, "A pair of kookoo-birds used to live in that hole, and I used to hear them bawling in the night." Then I asked him what the "bawling" sounded like, and he anwered "koo-koo, koo-koo", hence the local name. Then I enquired, "how many years, about, since you remember seeing or hearing the last koo-koo bird?" Taking a hold of his heavy jaw with his roughened hands, he was thoughtful a moment, then calmly answered, "Boss, it must be done gone over eight or ten years." I passed the word along among the North Side Villagers, that the person who could give me information leading to the capture of a "koo-koo bird" would be rewarded with five dollars. The offer still stands, but no owls.

62. *ANTROSTOMUS CAROLINENSIS* (Gmelin). Chuck-will's-widow.

Regular winter visitant. Nov. 9 (1); Nov. 12 (2), at Constitution Hill Estate. Jan. 1 (1); Jan. 16 (2), in the North Side Woods. Two specimens collected. Uncommon.

63. *ORTHORHYNCHUS EXILIS EXILIS* (Gmelin). Gilt Crested Hummingbird. Local Name "Doctor Bird".

Resident. Not so common as the larger species, and prefers the dense undergrowth of woods to the open country. A nest, made of cotton adorned with lichens, was taken Feb. 25, 1920, and was placed two feet above the ground in the crotch of a mahogany seedling. The two white eggs measured .44 × .31″, and .50 × .31″.

64. *SERICOTES HOLOSERICEUS HOLOSERICEUS* (Linné). **Blue-breasted Hummingbird. Local Name, "Doctor Bird".**

Resident. found everywhere, and on the neighboring islets. A nest with two white eggs was taken July 1, 1929 from a mahogany tree. The nest was made of cotton adorned on the outside with lichens. It was placed eight feet up, at the crotch of small horizontal branch. Eggs .54 × .41″, and .56 × .41″.

65. *STREPTOCERYLE ALCYON ALCYON* (Linné). **Belted Kingfisher.**

Regular winter visitant. Sept. 10 (1); Oct. 9 (4); Nov. 27 (6); Dec. 18 (6); Jan. 1 (2); Feb. 25 (1); Mar. 30 (4); Apr. 9 (3); May 1 (1). Frequents all the lagoons and ponds on the islands.

66. *SPHYRAPICUS VARIUS VARIUS* (Linné). **Yellow-bellied Sapsucker.**

Jan. 3, 1924, I shot a female from the branch of a "giant thibet" tree on La Grange Estate.

67. *TYRANNUS DOMINICENSIS DOMINICENSIS* (Gmelin). **Gray Kingbird. Local Name, "Chichery".**

Resident. A very common species, also found on neighboring islets. Breeds in May and June. Aug. 25, 1921, I took a set of three eggs, 1.08 × .78″; 1.08 × .78″; and 1.05 × .78″, from a nest which was constructed of fine sticks, deeply cupped and lined with rootlets, placed five feet up, on the branch of an acacia. The eggs were light salmon red, with large and small spots of deep reddish brown and brown, wreathed around the larger end.

68. *ELAENIA MARTINICA RIISII* (Sclater). **Riise's Elaenia.**

Resident. Increasing rapidly, now common. Ranges over the island and two neighboring islets. A nest found March 17, 1922, contained two eggs, .78 × .63″, and .81 × .63″, salmon with lilac and brownish spots, wreathed around the larger end. The nest was a frail platform of fine dry twigs, not lined, placed seven feet up on a bed of vines which draped over the top of a sapling.

69. *HIRUNDO ERYTHROGASTER* (Boddaert). **Barn Swallow.**

Regular transient visitor. Aug. 27 (40); Sept. 1 (12); Sept. 10 (60); Oct. 21 (24); Feb. 29 (30); March 30 (15); May 5 (50); June 5 (24); June 10 (1). Ranges over the island. Specimens collected.

70. *PROGNE DOMINICENSIS* (Gmelin). Caribbean Martin.

George Seaman observed a pair that remained in the vicinity of Estate Lower Love during 1917 and 1918, and evidently nested in a hole in the factory's smokestack. From March to July, 1923, I observed two pairs flying about the smokestack of the Bethlehem sugar factory, and I believe they nested in one of the draught holes 75 feet up.

71. *MIMUS POLYGLOTTOS ORPHEUS* (Linné). Jamaican Mockingbird.

Resident. They are increasing rapidly. Apr. 21, 1919, I collected a set of four eggs, 1.00 × .75″; 1.00 × .75″; .97 × .75″; .97 × .75″ pale bluish green heavily spotted with chocolate and brown, wreathed around the larger end. The nest was composed of coarse sticks lined with rootlets, placed two and a half feet above the ground in an acacia.

72. *MARGAROPS FUSCATUS FUSCATUS* (Vieillot). Pearly Eyed Thrasher. Local Names, "Thrush" and "Sour-sap Bird".

Resident. Very common among the "fruit gardens". June 15, 1921, I surprised a female on her nest, which was constructed of coarse sticks, scantily lined with rootlets, and placed at the bottom of a hole in an alligator pear tree. The three eggs measured 1.30 × .88″; 1.32 × .88″, and 1.30 × .88″, and were spotless glossy deep sea blue.

73. *VIREO OLIVACEUS OLIVACEUS* (Linné). Jamaican Vireo. Local Names, "John-chew-it", and "Greenlet".

Very common summer resident, also found on neighboring islets. They leave in August, returning in December and January, and nest in June. June 11, 1921, I found a nest suspended from the forked branch of a "turpentine" tree, twelve feet above the ground. It was made of soft grasses and cotton. The three eggs were all of the same size (.88 × .63″), and were white with fine blackish spots, wreathed around the larger end.

74. *COEREBA NEWTONI* (Baird). St. Croix Honey Creeper. Local Name, **"Yellow-breast"**.

Resident. Very common, ranging from seacoast to heavy woods. The breeding season is irregular. A nest, examined Sept. 30, 1921, was made of soft grasses and cotton, unlined, and situated four feet up in a sweet lime hedge; it was domed, with the entrance at the side. The three eggs were all the same size (.69 × .50″), and were white with a salmon tint, finely sprinkled with brown and chocolate.

75. *MNIOTILTA VARIA* (Linné). Black and White Warbler.

Regular winter visitant. Sept. 10 (4); Oct. 6 (8); Oct. 8 (6); Jan. 1; Jan. 6 (3). Not common, and keep to wooded localities. Specimens collected.

76. *COMPSOTHLYPIS AMERICANA PUSILLA* (Wilson). Northern Parula Warbler.

Regular winter visitant. Sept. 30 (4); Nov. 6 (12); Dec. 30 (20); Jan. 1 (25); Apr. 1 (30); Apr. 23 (30); Apr. 28 (1); Apr. 30 (10). Very common. Found in the woods, but more common in the sage brush. Specimens collected.

77. *DENDROICA TIGRINA* (Gmelin). Cape May Warbler.

Regular winter visitant. Sept. 8 (1); Nov. 14 (4); Dec. 11 (4); Dec. 30 (2); Jan. 1 (8); Feb. 10 (1); Feb. 23 (4); Apr. 19 (1). Uncommon. All these observations were made around Constitution Hill estate, where the birds kept to the open. Specimens collected.

78. *DENDROICA PETECHIA CRUCIANA* (Sundevall). Golden Warbler. Local Name, "Canary".

Resident. Rarely met with in wooded areas, preferring the open brush lands and mangrove bordered ponds and lagoons. Nests in May. A set of three eggs taken May 13, 1919, was white, with a greenish tint, spotted with blackish and gray, and wreathed around the larger end. The eggs measured .72 × .56″; .75 × .56″ and .75 × .56″ The nest was made of grass and lined with softer grasses, deeply cupped. It was placed three feet up in a "sage" bush.

79. *DENDROICA VIRENS VIRENS* (Gmelin). Black Throated Green Warbler.

Collected a male and female, Oct. 18, 1919, which were feeding on small green and brown caterpillars on a big "flamboyant" tree on Constitution Hill.

80. *DENDROICA DISCOLOR* (Vieillot). Prairie Warbler.

Regular winter visitant. Sept. 1 (10); Sept. 7 (25); Dec. 30 (1); Jan. 1 (20); Apr. 1 (30); Apr. 23 (25). Common. Found in the woods, but more abundant in the sage brush and open country. Specimens collected.

81. *DENDROICA PALMARUM PALMARUM* (Gmelin). Palm Warbler.

Regular winter visitant; common. Oct. 6 (10); Oct. 16 (1); Oct. 20 (4); Jan. 1 (20); Feb. 23 (1); Apr. 30 (1). Confine themselves to the open country.

82. *SEIURUS NOVEBORACENSIS NOVEBORACENSIS* (Gmelin). Water-thrush.

Regular winter visitant. Sept. 1 (4); Sept. 5 (6); Sept. 18 (10); Nov. 24 (20); Jan. 1 (15); Mar. 20 (10); Apr. 14 (10). Common along streams, ponds and lagoons. Specimens collected.

83. *SEIURUS AUROCAPILLUS AUROCAPILLUS* (Linné). Ovenbird.

Regular winter visitant. Sept. 15 (4): Dec. 30 (20); Jan. 1 (20). Common in the woods.

84. *WILSONIA CANADENSIS* (Linné). Canadian Warbler.

Feb. 17, 1924, I startled a cock of small birds that were feeding among the scrub mangroves bordering the Salt Pond. Following them for quite a distance I finally succeeded in obtaining a male which was in perfect plumage. There were about ten altogether.

85. *SETOPHAGA RUTICILLA* (Linné). Redstart.

Regular winter visitant. Sept. 1 (6); Sept. 7 (4); Dec. 30 (3); Jan. 6 (5); Apr. 1 (1); Apr. 23 (15). Common in the woods, seldom seen in the open country. Specimens collected.

86. *HOLOQUISCALUS NIGER BRACHYPTERUS* (Cassin). (Lawrence). Porto Rico Blackbird.

Introduced from Porto Rico about 1917 at the "Whim" Estate, where they appeared to be doing very well, nesting in the large "thibet" trees around the proprietor's mansion. Nov. 10, 1919, a pair had wandered as far as estate Constitution Hill.

87. *PIRANGA ERYTHROMELAS* (Vieillot). Scarlet Tanager.

Shot a male Apr. 20, 1919 which was feeding among the branches of a "turpentine" tree growing on the grounds of Peters Rest Public School. Perfect adult plumage.

88. *TIARIS BICOLOR OMISSA* (Jardine). Garib Grassquit. Local Names, "Sin-bird", and "Sparrow".

Resident. Common everywhere excepting the heavy woods. Irregular nesting season. A nest and three eggs were collected Sept.

25, 1923. The domed nest was made of soft grasses, not as compactly woven as the nest of the Honey Creeper, and placed three feet up in an acacia. The entrance was at the side. The eggs measured .69 × .53″; .69 × .53″, and .72 × .53″. The ground color was light grayish white, and they were sprinkled with dark brown, especially around the larger end.

A NEW LEAF-MINER OF COTTON IN PORTO RICO

(NEPTICULA GOSSYPII new species)

By W. T. M. FORBES[1] and M. D. LEONARD[2]

INTRODUCTION

On March 6, 1930 a small cotton field was found near Juana Díaz in which the leaves were severely infested by a leaf-miner. A minute moth which appeared black-and-white banded to the naked eye, was noticed on a number of the leaves and judged to be associated with the trouble. Facilities were lacking at the time for collecting and preserving specimens, but a quantity of the mined leaves were gathered.

During the course of that day and the next, a number of cotton fields were carefully examined in the vicinity of Ponce, Tallaboa, Yauco and Sabana Grande, and the leaf-miner was found to be present in all, with one or two exceptions, in greater or less numbers. Most of the mines seemed to be empty and moths were not again observed, though they are so small as to have been easily overlooked.

On March 8th several fields of cotton were examined in the vicinity of Arecibo and Camuy on the North Coast. The cotton here was all young, being only a few inches high. Two or three leaves only were found showing a small mine or two apiece.

Upon reaching the laboratory in Río Piedras on the 10th it was found that the leaves had either badly moulded or had dried. Three greenish lepidopterous larvae, however, were dissected from the end of fresh mines and one naked pale greenish pupa was found on the surface of a leaf. These all died in a day or two.

No reference to a leaf-miner in cotton could be found in literature available nor any record of such in the files of the Insular Experiment Station. Nor was a leaf-miner mentioned in the paper on "Cotton Insects of Porto Rico" by E. G. Smyth, Ent. News 31: 121–125, 1920.

Further opportunity to collect additional material did not present itself until April 5th, 1930 when in company with Dr. J. G. Needham of Cornell University a field of cotton was visited near the one first-mentioned near Juana Díaz. The work of the leaf-miner was exceedingly abundant but all the mines examined were empty and no moths could be found. Another field just north of Villalba was found to be much more lightly infested but here three or four mines were found containing larvae.

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From these two fields a considerable number of leaves was brought back to the laboratory. It was not possible to examine them carefully until the 8th. On this date a number of cocoons were found, mostly on the lower surface of the leaves, and three or four larvae were dissected from the mines. The cocoons were confined in shell vials and on the 15th eight moths were found, a couple of these undoubtedly having emerged the day before, since they were already dead. On April 16th four more moths had emerged and on the 17th three additional adults were obtained.

Further field observations were made in two cotton fields on April 18th near Guayanilla. In one, a dry field where no new leaves were being put out the mines were old and apparently all deserted. Every leaf examined, however, had been infested, many having numerous mines. In the other field the plants were producing new foliage. Here the condition of the old leaves were as in the other field: the new leaves showed a moderate number of fresh mines.

FOOD PLANTS AND ORIGIN

The cotton referred to in this discussion is all Sea Island cotton (*Gossypium barbadense* L.). This type is being increasingly grown commercially in Porto Rico and is found by many farmers to be a profitable crop, especially desirable in some cases as a substitute crop on land which will not produce a profitable crop of sugar-cane. There was during the growing season of 1929–1930 about 14,000 acres of Sea Island Cotton in Porto Rico, divided between about 4,000 acres on the South Coast and about 10,000 on the North Coast.

On April 24 and again on May 20 a number of fields were examined on the North Coast throughout the length of the cotton growing belt. Altho by the latter date a number were well along towards maturity and the plants large no evidence of the presence of the leaf-miner could be found. On May 21st several fields were examined on the South Coast. The plants were all old and the crop had apparently matured and been for the most part picked. Abundant evidence was present of earlier infestation, but even where green, fairly new foliage was present, no new infestation could be found. The same condition obtained about ten days later. Apparently there is a distinct season of activity and non-activity of the insect in relation to the cotton on the South Coast.

Casual search on tree cotton (*Gossypium hirsutum* L.) has failed so far to disclose evidence of this leaf-miner on the Island of Porto Rico. On April 30th, however, we examined several tree cotton plants near Puerto Real on Vieques Island. One leaf had a small mine which appeared to be characteristic of this species. We have as yet had little opportunity to search for it in other species of *Gossypium* known to occur in Porto Rico, or in other Malvaceae of which there are several species occurring here.

It cannot be determined at present whether this leaf miner is indigenous to Porto Rico or not. So far as we can ascertain, no Nepticula has yet been recorded from the West Indies, and no Nepticula has yet been bred from cotton in any part of the world. It seems unlikely that an insect whose work is so conspicuous on a crop that has been so carefully observed by official entomologists in the past, should have been entirely overlooked, so there is a possibility that the species has recently come over from some other Malvaceous food, or from some other part of the world. The two-banded species of Nepticula seem to be most characteristic of the New World, however, and the probability is that the species is actually indigenous to the Antilles or to Central America. It should be sought for in the other cotton growing areas of this zone, especially in regions where cotton is grown in small amounts or semicommercially among native vegetation.

Description of the Stages

THE EGG (PL. XV, FIG. 6)

Unhatched eggs have not been found, but the egg-shell is as follows: about .17 mm. in length and about .14 mm. at greatest width; broadly elliptical, somewhat convex on free surface, shining, translucent white, and without noticeable sculpture under the high power binocular.

THE LARVAE (PL. XV, FIG. 2)

Length 2.5 mm.; green with the chitinized parts of the head pale brownish; somewhat flattened; the legs represented by high conical projections or lobes on the meso- and metathorax and on the 2nd to 7th segments of the abdomen; first and last 3 abdominal segments noticeably reduced in size; the structure of the head and the arrangement of the setae are as usual in the family.

THE PUPA (PL. XV, FIGS. 4 AND 5)

Length, 1.3–1.5 mm.; color pale green, the abdomen somewhat darker, without markings; cuticle thin, soft and transparent; of a modified incomplete type, stout and flattened; wings and hind legs reaching to end of body; antennæ half as long; tongue rudimentary; appendages soldered but not strongly so, with all their parts easily recognizable; prothorax much narrower than head in dorsal view; abdominal segments effectively immovable; no obvious setae or spines except on the last segment which has a larger anterior pair of projecting teeth and a smaller posterior pair; last abdominal segment truncate and slightly bifid behind; middle abdominal segments each with a transverse row of spiracles, only distinctly visible on the cast pupa-shell; scape very large, covering the eye except a small ventral portion; maxillary palpi conspicuous, transverse, extending behind the eye from antenna to maxilla; labial palpi short, completely exposed, the short tongue and labial palpi leaving the ventral surface of the body largely exposed.

THE COCOON (PL. XV, FIG. 1)

About 1.8 by 1 mm. White, oval, flattened, strongly narrowed to the posterior end where it is stained by a brown dot of the last frass; broadly rounded at the anterior end, where there is a horizontal slit its whole width, for the emergence of the moth, closed before emergence by a few silk threads. The cocoon usually bulges on one side more than the other.

THE ADULT (PL. XV. FIG. 3)

Expanse 2.8 mm. Black, with a slight purple irridescence. Head cream color, including palpi, occiput and eye-caps; tuft deep ochre or dull tawny. Antennae fuscous. Fore-wing with two pale-gold fasciae, the more basal one somewhat darker and slightly less iridescent, twice as wide on inner margin as on costa, and with its outer boundary somewhat offset on the fold (see figure); second fascia somewhat widened to inner margin and slightly constricted at middle of wing, slightly wider than first fascia at costa, but much narrower at inner margin. Apex more shining, occasionally appearing silvery in a favorable light. Fringe about apex with a black basal line, the outer part nearly white and strongly contrasting, dorsal fringe mouse-gray. Hind-wing light gray with mouse-gray fringe. Thorax lead-gray, the tegulae somewhat darker. Abdomen fuscous.

We have come across no description of an old-world Nepticula that could be confused with this. In Miss Braun's key[3] it will run most nearly to *N. bifasciella* Clemens, from which it will differ by the fact that the ground of the fore-wing is all of one color, and by the much smaller size. The two bands of *N. epicosma* Meyrick '15, from South America, differ in position.

Type locality. Juana Díaz, Porto Rico, Holotype and eight paratypes, Cornell University, type No. 948.

THE MINE (PL. XVI)

Slender, sinuous, but if straightened out would be on the average rather more than 25 mm. in length; ends in the usual slight enlargement with a crescent-shaped emergence hole on under surface of the leaf. In the first half of the mine the frass is arranged in a zig-zag line of arcs, each arc being composed of half a dozen dots. In the latter half of the mine this changes over into a single continuous line of fluid frass; the transformation being either abrupt or gradual. In weathered mines the zig-zag first portion of the frass line tends to disappear. The mines cross each other freely and infrequently run into each other.

In fresh leaves on the plant the mines are almost invisible on the upper surface but when the lower surface is examined they may be readily traced since their surface is noticeably raised and in the older portions the mines are slightly reddish or purplish. When the leaves become old and dried the mines become whitish in marked contrast to the darkened leaf surface and are then especially conspicuous on the upper surface.

LIFE-HISTORY

Pressure of other work and lack of sufficient opportunity to rear moths in confinement have not as yet permitted us to determine the full life-history of the cotton leaf-miner. Some information has however been accumulated.

The eggs themselves have not been found but the egg-shells could be readily located under a high power binocular by tilting the leaves slightly towards the sun-light when they then appeared on the lower surface as tiny glistening dots. This simple method of locating Nepticula eggs was suggested by Prof. C. R. Crosby of Cornell University in his bulletin on the plum leaf-miner, *Nepticula slingerlandella* Kearfott, (Cornell Univ. Agr. Exp. Sta. Bul. 308, 1911). Egg-laying has not been observed but probably takes place in the evening or at night as is the case with several lepidopterous leaf-miners, including the coffee leaf-miner (*Leucoptera coffeella* Guérin) and probably with the plum leaf-miner. The eggs are laid singly on the undersurface of the leaves, and as far as observed in the fork of two veinlets, a portion of the edge of the egg often being somewhat concealed beneath the veinlet, so closely is it applied to the veinlet. A small blackish dot of frass can usually be seen within the empty egg-shell. The larva upon hatching apparently enters the leaf tissue directly thru the surface of the egg-shell next to the leaf since no break in the chorion is noticeable on the side away from the leaf surface. The mine undoubtedly starts at the egg-shell but is usually indistinguishable for a short distance away from it.

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[3] Nepticulidae of North America. Trans. Am. Ent. Soc. 43: 155, 1917, largely reprinted in the "Lepidoptera of New York", Cornell Univ. Agr. Exp. Sta. Memoir 68: 84–86, 1923.

In the laboratory where infested leaves have been confined in jars or boxes, the larvae, when full-grown, have always formed their cocoons on the leaves. These have been attached usually to the underside against a vein and so firmly as to permit dissecting out the pupa with a single needle without tearing the cocoon loose from the leaf. It may be that in nature pupation takes place in the soil. We have been unable to find cocoons on the leaves in the field even in heavily infested cotton. As further evidence of this possibility two or three naked pupae have been found on the surface of a leaf in the laboratory. The length of the pupal stage is apparently about a week to ten days; or at least that is the time elapsing from the formation of the cocoon to the emergence of the adult.

When ready to emerge the pupa works its way forward, splitting the very thin silk at the anterior end of the pupa about one-third the way down. The empty pupa shell projects slightly from the cocoon. Emergence apparently takes place in the early morning, since the moths were found only in the morning in the shell vials in which pupae had been confined and never by late in the afternoon.

PARASITES

Several specimens of a black and of a yellow Chalcis fly have been observed on leaves confined in the laboratory and infested with this leaf-miner. They undoubtedly are parasitic, although this point has not yet been definitely established. The leaf-miner is easily susceptible to parasitism in the mines and undoubtedly further observations will establish parasitism since the coffee leaf-miner also seems to be readily parasitized in Porto Rico.

Economic Importance

During the three months this leaf-miner has been under observation it has not been difficult to find cotton fields of one to several acres in extent in the southern part of the Island in which almost literally one hundred percent of the leaves have been infested. Some of the younger and smaller leaves will contain but a single mine while many older and larger one's may have many mines. Apparently, however, little premature shedding of the foliage occurs even on plants which are severely infested. It must be regarded therefore at the present time as merely a minor pest of cotton but of possibly greater potential importance in the future. It is difficult to believe, however, that as considerable infestations as have been observed should not interfere to an appreciable extent with the proper functioning of the leaves with consequent reduction in size and quality of the crop.

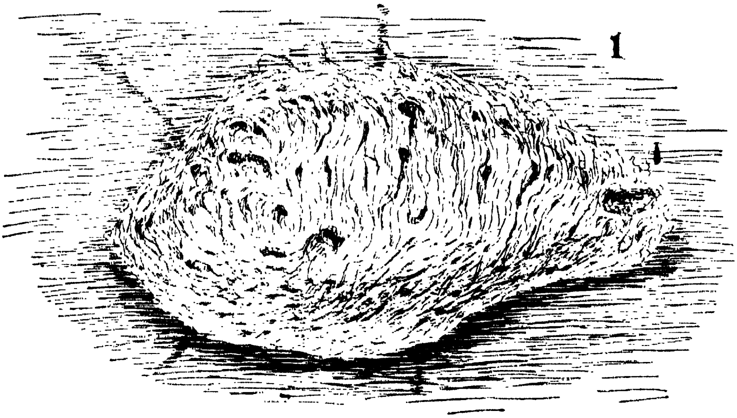
Should the insect assume sufficient proportions at any time in the future so as to make remedial measures seem worth while one or two thoro applications of nicotine sulfate ("Black Leaf 40"), 1 part in 800 parts of water, directed against the underside of the leaves would undoubtedly kill a large proportion of the larvae in the mines. This material is used very successfully for the control of the coffee leaf-miner, *Leucoptera coffeella* Guérin, in Porto Rico in the seed beds. In order to cheapen the cost of the spray as far as possible a considerably greater dilution of the nicotine sulfate could undoubtedly be used by adding a sufficient quantity of Penetrol, a recently discovered very effective activator for nicotine.

EXPLANATION OF PLATES

Plate XV. (All greatly enlarged)
- Fig. 1 Cocoon.
- Fig. 2 Full grown larva, side view.
- Fig. 3 Moth.
- Fig. 4 Pupa, ventral view.
- Fig. 5 Pupa, dorsal view.
- Fig. 6 Egg.

Plate XVI. (About three-fourths natural size)
- Cotton leaves showing old, weathered mines on upper surface.

PLATE XV



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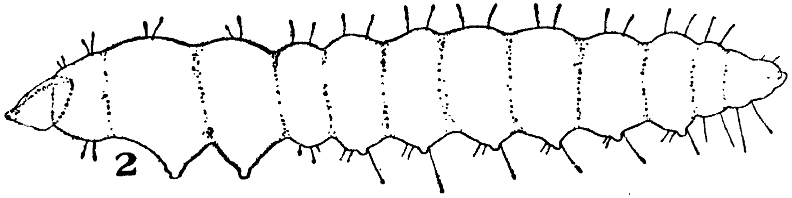

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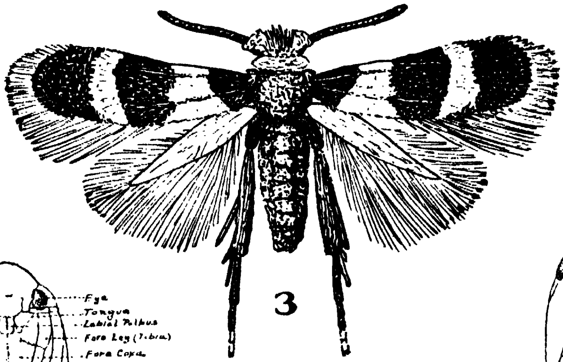

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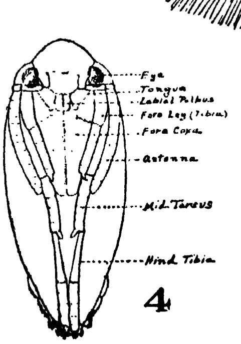

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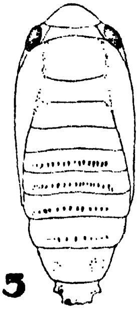

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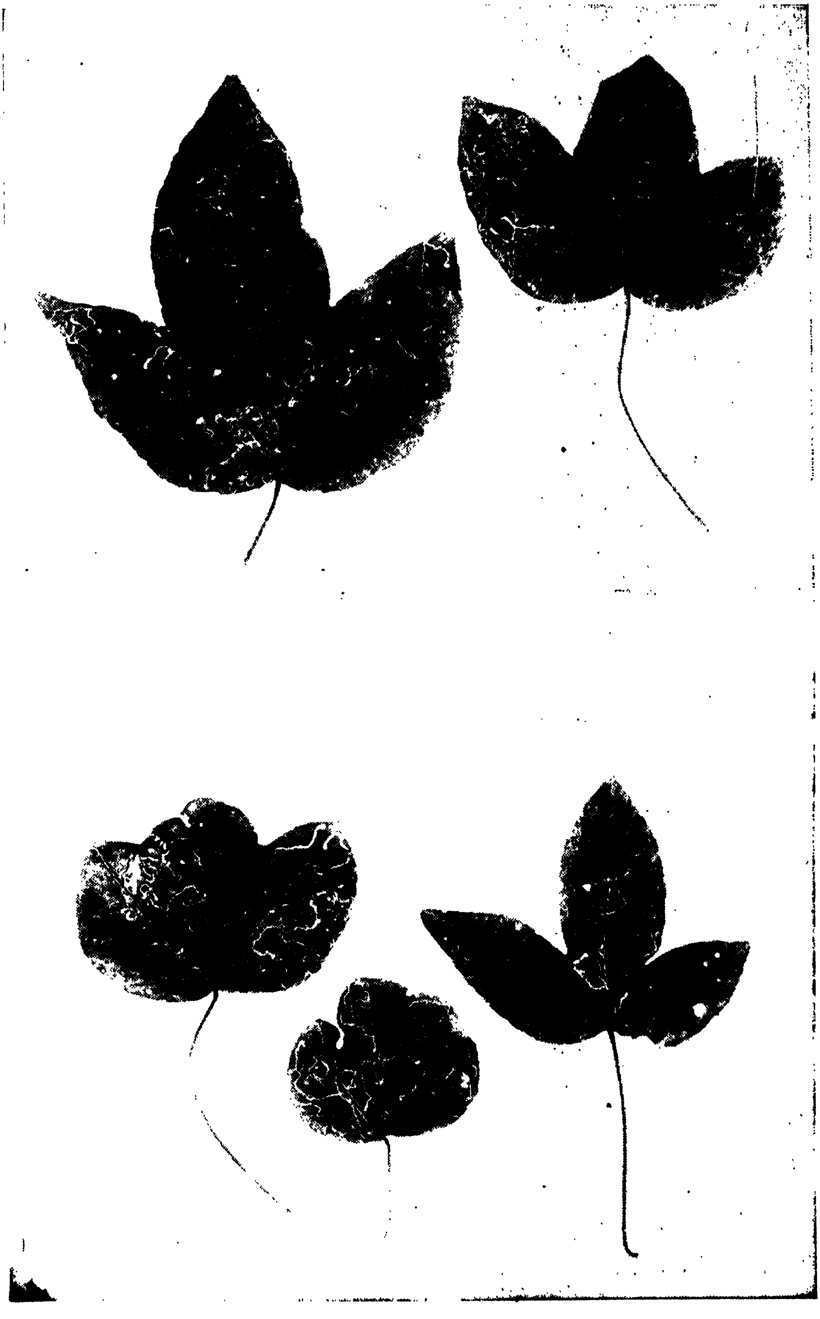
PLATE XVI



A LITTLE-KNOWN ROOT-WEEVIL OF CASSAVA

(COELOSTERNUS SULCATULUS BOHEMAN)

By Mortimer D. Leonard

Introduction

Under date of March 5, 1930, roots of cassava, or yuca as it is locally called, infested with a weevil were received from Mr. I. L. Torres, Director of Extension of the Insular Department of Agriculture. These had been sent in by Mr. J. B. Román, Agricultural Agent at Comerío, accompanied by a letter saying that he had personnally seen the planting and that appreciable damage had been done to it.

An adult weevil which had been dug out of the roots accompanied the specimens and several larvae were found in the roots. Subsequently two or three more of the adults emerged.

Specimens were submitted to Mr. Chas. W. Leng of the Staten Island (New York) Public Museum who replied that he and Mr. A. B. Mutchler of the American Museum of Natural History were unable to place the species. They therefore submitted it to Dr. Guy A. K. Marshall of the British Museum who determined it as *Coelosternus sulcatulus* Boheman, with the statement that it was originally described from Guadeloupe and had previously been represented in the British Museum by but a single specimen.

On March 21, in company with Messrs. Torres and Román the writer visited the farm where the weevil had been found. It is owned by Don Pedro Tañón in the Barrio of Doña Elena and is at about 1,800 ft. altitude, an hour by horseback up in the mountains. There had been about 2 acres planted in cassava which had been recently dug, the entire plants having been laid aside to dry out. From personal examination and from conversation with the grower we estimated that about 10 per cent of the roots were worthless altho the actual percentage of plants infested was somewhat higher than that. A new planting had been made and the shoots were just beginning to show above ground but we were unable to find any weevils or larvae in or near the "seed" pieces altho they were close to the old planting. The grower stated that he had not previously observed such damage, altho he had grown yuca for several years. We were unable to learn from where he obtained the "seed" for the original planting on his farm but presumably it was from some nearby plantation, since cassava has been grown in that section for a considerable length of time.

The only reference I have been able to find to a weevil infesting yuca is by R. S. Cunliffe (Yuca, Su Cultivo, Variedades, Contenido en Almidón y Fabricación. Cuba Est. Exp. Agron. Bol. 34: 57–58, 1916) who states that in the island of St. Vincent a species of Cryptorynchus has been found as a stem borer [taladrador del tallo]. I have, however, been unable to locate the original in any of the reports of the St. Vincent Department of Agriculture upon which Cunliffe must have based this statement. Furthermore F. W. Urich in a paper entitled Cassava Insects in Bul. Dept. Agr. Trinidad and Tobago 14 (2): 38–40, 1915, gives records of cassava insects in other countries but makes no mention of this weevil in referring to the pests of the crop recorded from St. Vincent.

History and Distribution

Coelosternus sulcatulus Boheman was first described in Carl J. Schoenherr's "Genera et Species Curculionidum", IV (I): 220, 1837. The locality is given as Guadeloupe. The number of specimens upon which the original description was based is not stated. With the exception of the specimen in the British Museum it has not since been noticed until found last March in Porto Rico. Altho since that time several plantings of yuca in the vicinity of Río Piedras and to the West along the North Coast to Arecibo have been examined, no further infestations have been found. It is possible that the species has become established in the higher altitudes in the Island but inquiry among the Agricultural Agents has so far failed to bring any further report of its presence.

Food-Plant and Nature of Injury

Cassava or yuca, *Manihot Manihot* (L.) Cockerell, is generally grown throughout the Island in small patches of usually an acre or two or even less. Altho none is grown for the commercial production of starch it forms an important source of food for the natives who eat the edible storage roots.

Strictly speaking it is not the roots themselves but the underground part of the stem in which the larvae feed. The plants found infested near Comerío had the basal, woody part of the stem which lies immediately underground and usually parallel to its surface, tunneled by the grubs. Altho the larvae do not feed in the storage roots, injury to the underground part of the stem weakens the whole plant and reduces the size and quality of the storage roots.

DESCRIPTION OF STAGES

THE LARVA (PL. XIX FIG. 3)

Length about 10 mm., body strongly curved; yellowish-white to pale brownish yellow with head capsule reddish brown, mandibles blackish.

Some of the more important features of the larva appear to be as follows: body strongly curved, the first, second and third abdominal segments being slightly smaller than the remainder and than the thoracic segments, giving the body a somewhat constricted appearance at the middle. A large, elongate spiracle on the prothorax, about three times the length of the abdominal spiracles which are distinct and of moderate size, that of the eighth segment being uniform in size and shape with the others. Body glabrous except for the pale hairs found on each segment which are very fine, short and sparse. The eighth segment bears a pair of well developed setae towards the median line at about two-thirds of its length caudad when viewed laterally, from which point it slopes sharply to the caudal border; a well developed seta is located on each side on a prominent protruberance caudoventrad of the spiracle. The ninth segment is much smaller than the eighth and only about one-half its width viewed laterally; it bears one set of setae on either side. The tenth segment is very small and glabrous and is neither dorsal nor ventral but more nearly terminal, the tip being just visible in lateral view protruding beyond the border of the ninth.

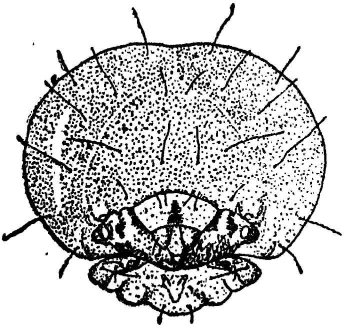


Fig. A.
Head of Larva

The details of the mouth-parts (as far as could be determined) and of the arrangement of the setae on the head are as shown in text figure A.

THE PUPA (PL. XVIII FIGS. 1 AND 2 AND PL. XIX, FIGS 1, 2, 4)

(Description drawn up from one specimen nearly ready to change to an adult and therefore brownish yellow with abdomen and parts of head dark brownish.)

Length, about 12 mm. At first whitish, later becoming yellowish to brownish yellow as development advances.

A prominent thoracic spiracle is located at the base of the prothorax. The beak has two transverse depressions just apicad of the antennae. There are seven prominent setae on tubercles on the head one on either side of the median line near the vertex and a transverse row of five just above the eyes, the middle one being just to the left of the median line. The frons bears two median setigerous tubercles. On the beak are setae on tubercles, but somewhat smaller, three on each half (viewed from in front); just above the base of the antennae, and near the tip of the beak are two more, still somewhat smaller.

The prothorax when viewed from above is almost twice as wide as long, rounded in front and about one-third the way caudad swelling laterad to about twice the width. The basal angles are slightly extended backwards and the caudal border is extended caudad at the median line into two small protruberances thus giving the caudal border a sinuous outline. The prothorax bears eight pairs of prominent setigerous tubercles one apical and one subapical, one antero-median and one antero-lateral, three postero-lateral, and one postero-median. There are a number of irregularly scattered spines, somewhat smaller and less numerous towards the middle and hind part of the disc. Mesothorax with two pairs of smaller setigerous tubercles. Metathorax with a median transverse row of three still smaller setigerous tubercles on either side.

The first six abdominal segments viewed dorsally are about equally wide cephalo-caudad, gradually decreasing in width laterally and each with a transverse row of small setigerous tubercles near the caudal margin; the seventh somewhat wider but narrower with a transverse row of larger setigerous tubercles; the eighth still smaller both ways, posterior margin strongly convex and with two prominent median setigerous tubercles; the ninth segment small, transverse, with each postero-lateral angle prolonged into a prominent chitinous process, below each of which is a small setigerous tubercle; the tenth segment is not visible from above but when viewed from below is small and appears to be protruding slightly from the encircling ninth segment; it is apparently glabrous.

Femora each with two prominent subapical setigerous tubercles on outside. Wing-pads extend to about the caudal border of the sixth abdominal segment. Longitudinal ridges on the wings prominent and with numerous small setigerous tubercles.

THE ADULT (PL. XIX FIG. 5)

The adult weevil is 6 to 7 mm. in length. Messrs. Leng and Mutchler have been kind enough to furnish me with a brief diagnosis and with a copy of the original description both of which follow quoted in full:

"Head with a V-shaped raised ridge behind the eyes; coarsely punctate; scaly, scales on basal part smaller than on apical; apical end of the beak smooth shining but beginning on the apical half there are raised ridges, the middle one of which continues back to the base; basal half covered with scales. Scape of antennæ moderately short; funicle seven jointed, second joint longer than the third; club elongate and somewhat thickly pubescent. Pronotum suddenly narrowed at apex and with a prominent raised median ridge on the apical half; coarsely punctate; vestiture consisting of rounded and elongate scales, sides more densely scaly; ocular lobes prominent. Elytra with the alternate striae prominent, intervals coarsely punctate and granulate, vestiture consisting of rounded and elongate scales. Under surface and legs somewhat densely scaly. Femora with two teeth on the apical half the one nearest the apex being the smaller; tibiæ curved and with a curved tooth at the apical end."

"Male, female. 22. *C. Sulcatulus.* Chevrolat.

"Ovalis, niger, dilute fusco-griseo-squamosus; rostro tenui, valde arcuato, basi confertim punctato, carinato; thorace punctatissimo, dorso antico argute carinato; elytris subtiliter bifariam punctato-striatis, interstitis alternis carinatis; femoribus clavatis, omnibus bidentatis.

"*Patria:* Guadeloupe. A Dom. Chevrolat amice communicatus. Mus. Schh.

"Magnitudo, statura et summa similitudo *Cryptorhynchi haemorrhoei;* clava antennarum elongata, rostro basi tantum carinato, thorace antice carinato, femoribus omnibus bi-dentatis, ab illo distinctus. Caput breve, convexum, rugoso-punctatum, nigrum, squamis, depressis, fusco-griseis, tectum, vertice linea arcuata praedito; oculi oblongi, haud prominuli, brunnei; rostrum longitudine thoracis, subtenue, teres, valde arcuatum, obscure ferrugineum, basi crassius, ibique supra carinatum, punctatum, squamulosum, de in extrorsum nudum, nitidum, sub-laeve. Antennae in medio rostri sitae, subtenues, dilute ferrugineae, clava elongata, cinereo-pubescente. Thorax latitudine baseos brevior, anterius angustior, apice utrinque emarginatus, leviter constrictus, lateribus valde rotundato-ampliatus, basi bi-sinuatus, supra modice convexus, confertim punctatus, niger, squamulis unicoloribus fusco-griseis dense vestitus, in medio dorsi carinula sat elevata, postice abbreviata, instructus. Scutellum parvum, oblongum, nigrum, punctatum. Elytra antice thoracis basi nonnihil latiora et illi arcte adaequata, humeris obliquis, obtuse sub-rotundatis; a medio apicem versus attenuata, apice ipso conjunctim rotundata, thorace vix triplo longiora, supra valde convexa, postice declivia, punctis parvis, per paria approximatis, squama pallida repletis, striata, interstitiis alternis costatis, alternis planis; nigra, squamulis fuscogriseis dense tecta. Corpus subtus nigrum, crebre punctatum, dense dilute umbrino-squamosum. Pedes longiusculi, validi, nigri, punctati, squamulis dilute umbrinis tecti; femoribus clavatis, omnibus subtus bi-dentatis, dente anteriore valido, posteriore parvo; tibiis nonnihil arcuatis, apice uncinatis; tarsi elongatis, subtus fulvo-spongiosis.—Bhn."

FURTHER NOTES

In all, eight adults have been collected or reared, seven of which were on March 5, 17, and 21, 1930. The eighth pupated in its tunnel on about March 30 and the beetle emerged about 3 weeks later, although the adult had remained in the pupal cell for several days before actually emerging from its exit hole in the wood.

Of these specimens four are in the Collection of the Insular Experiment Station at Río Piedras, P. R., and four were sent to Messrs. Leng and Mutchler, one of which is presumably in the British Museum.

The entire length of the pupal cell is about 20 mm., each end being plugged with sawdust to a depth of 5–7 mm. in order to hold the pupa securely in place. The diameter of the cell is about 4 to 5 mm. (pl. XIX, figs. 1 and 2.)

A LONGICORN TWIG-BORER

On March 5, when the farm near Comerío was visited for the purpose of observing the root-weevil a number of the cassava twigs were found to contain a coleopterous twig-borer belonging to the family Cerambycidae. Unfortunately only one larva and one pupa were preserved so that the specific identity is in doubt. The larva measures about 18 mm. and is a dirty yellowish white. The pupa is about 8 mm. in length and of about the same color.

Patricio Cardin (Bul. 20 Est. Exp. Agron. Cuba, 1911, pp. 14–17 and 24, Pls. V and VII) has discussed the injuries of two longicorn twig borers in cassava in Cuba. According to notes on file in the Insular Experiment Station, the more common of the two observed by Cardin in Cuba, *Lagochirus obsoletus* Thomas, was determined by Dr. E. A. Schwarz under this name, from a specimen collected at light by D. L. Van Dine on March 26, 1911, in the Condado section of Santurce, P. R. It is listed, however, in Wolcott's "Insectae Portoricensis" (Jour. Dept. Agr. P. R. 7 (1): 110, 1923) under *L. araeniformis* L. This latter species is recorded (1. c.) also from the Central Mercedita, Yabucoa, P. R., Jan. 29, 1913 and from Río Piedras, Apr. 15, 1912 (Van Dine Coll.) and Apr. 18, 1917 (R. T. Cotton Coll.) each from a single specimen collected at light. Presumably Cardin was really working with *L. araeniformis* in Cuba. The species is undoubtedly a cassava feeder in Porto Rico but the pests of this plant have been little studied here. The Comerío material collected by the writer is undoubtedly however not this species, since according to Cardin the full-grown larva of *L. araeniformis* measures about 29 mm. in length.

The second longicorn discussed by Cardin, as a minor pest of cassava *Leptostylus biustus* Lec., is not recorded in Wolcott's List from Porto Rico. It is possible however, that the Comerío specimens may belong to this species since it is apparently considerably smaller than *L. araeniformis.*

EXPLANATION OF PLATES

PLATE XVII.

Section of part of underground cassava stem cut open longitudinally to show tunnels made by the larvae. About natural size.

PLATE XVIII.

Fig. 1. Ventral view of pupa in its cell, about twice natural size. Note plug of sawdust at each end.
Fig. 2. Dorsal view of pupa in cell, same size.

PLATE XIX.

Fig. 1. Pupa, ventral view, above 3 × natural size.
Fig. 2. Pupa, dorsal view, about 3 × natural size
Fig. 3. Larva, lateral view, about 3 × natural size.
Fig. 4. Pupa, lateral view, about 3 × natural size.
Fig. 5. Adult, dorsal view, about 2½ × natural size.

PLATE XVIII

1

2

PLATE XIX

1

2

3

4

5

THE SUGAR CANE ROOT CATERPILLAR[1] AND OTHER NEW ROOT PESTS IN PUERTO RICO[2]

By Francisco Seín, Jr.

Introduction

The sugar cane root caterpillar was discovered by the author on the grounds of the Insular Experiment Station, Río Piedras, Puerto Rico, in the month of November, 1925. The first caterpillar was found above ground late in the afternoon in cloudy, rainy weather. It had the anterior part of its body inserted into a tunnel in the tender part of an aerial cane root from which it was throwing out whitish excrement and upon being disturbed it ran for cover into the soil. Digging in the soil around the cane plant many of the roots were found to have been tunneled, the whitish excrement was observed near the injured roots and several of the caterpillars were collected. They were reared to adult in the laboratory on sugar cane roots.

Systematic History

The adults of this root-boring caterpillar were submitted to the late Dr. H. G. Dyar of the United States National Museum who determined them as *Sufetula grumalis* Schaus (Pyralididæ Pyraustinæ). In the annual report of the Director of the Insular Experiment Station of Puerto Rico for the year 1925–26, a few notes were published on the habits *S. grumalis* abstracted from the Report of the Division of Entomology which latter was not published in full that year. In the Annual Report of the Insular Station for the year 1927–28, in the Report of the Division of Entomology, the author reported that the study of the sugar cane root caterpillar had been carried to a point where it became evident that an error had been committed when it was determined as *Sufetula grumalis* Schaus.

The error is clearly explained by the venation of the fore wing; R_5 is stalked with R_3 and R_4 (Pl. XXVI). The stalk varies somewhat in length as shown in Fig. 20. According to the key given by Hampson, (4) this character makes it impossible to place the sugar cane root caterpillar in the subfamily Pyraustinæ to which the genus *Sufetula* belongs.

The key to the subfamilies of the Pyralididæ given by Forbes (3) is intended to cover New York and neighboring States, U. S. A. If we try to run the Puerto Rico moth by this Key we find that there is no place for it. The first *1* reads: "Vein 1st A preserved in fore wing; tongue weak or absent; fringe on Cu weak or absent: Schœnobiinæ." The second *1*, or the alternative is: "Vein 1st A absent in fore wing."

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[1] *Perforadix sacchari*, new genus and species.

[2] The name of the Island of Porto Rico has officially been changed to its original form.

The Puerto Rican moth has vein 1st A preserved in the fore wing but its tongue is present, well developed and functional. Dr. Forbes' key could be enlarged to take in the new Pyralid by inserting another *1* between the first and second to read as follows: *1.* Vein 1st A preserved in fore wing; R_5 stalked with R_3 and R_4; tongue well developed: Endotrichinæ.

In the key for the subfamilies of the Pyralidæ devised by Hampson (4) for the Old World the Puerto Rican moth runs into the Endotrichinæ, but in the key given by the same author for the genera of this subfamily (5) it does not fit into any but comes nearest to *Diplopseustis*. The author has therefore erected the genus *Perforadix* for the Puerto Rican moth, the description of which follows:

The Genus *Perforadix* new genus, smaller moths, about ⅜ as large as *Diplopseustis minima*.

Labial palpi (Pl. XXVII, fig. 21b) obliquely upturned (in dead specimens may be porrect) the second joint longer than the head, thickly scaled and triangular, the third obliquely upturned and set at upper side of end of second (before apex in *Diplopseustis*, see Pl. XXVII, fig. 21a). Maxillary palpi more than half as large as the labial, third and fourth each very much broadened at tip and triangularly scaled. Eye large. Antennæ simple and ciliate (Pl. XXVII, fig 22). Tongue well developed. Fore wing nearly three times as long as wide, broad at base, obliquely truncate at apex and slightly notched opposite cell. Discocellular vein obliterated, at most only very short stubs. Vein 1st A is a developed tubular vein at margin with interspaces of the normal width between it and the veins above and below it. (Vein 1st A is also present in *Diplopseustis minima.*) Vein Cu_1 almost from angle of cell; vein 3rd A entirely lost. Hind wing with wavy outer margin, the notch a little deeper between veins M_1 and M_2; discocellular vein obliterated; vein Cu_2 from before angle of cell; Rs a short vein between base of M_1 and Sc; R extending to about center of cell and then disappearing; 1st, 2nd and 3rd A faintly marked.

The Type of this genus is the following species:

Perforadix sacchari new species. Wing expanse of 1cm. in the female and 9 mm. in the male. The color varies from dirty cream to a pinkish buff with some smoky shading. Costal edge dark with three half ocellated spots defined with dark bars. Ante- and post-medial lines slightly paler, the ante-medial defined with dark beyond and the postmedial before. Spots at the costa antemedial outly oblique to the fold, strongly innerly oblique and irregular to the edge, the dark edge emphasized on cell fold and inner margins. Outer line (post-medial) nearly perpendicular to opposite cell then oblique to inner margin, the border emphasized with dark towards the inner margin. Ante-post-medial lines emphasized by light and dark at the costa. Some black terminal dots, two at the notch opposite the cell and one at the lower notch more or less emphasized. Discal dot dark, vague and transverse; two or three inconspicuous lines in the fringe. Hind wing with black discal dot, a dark followed by a pale post-medial shade slightly excurved and black terminal dots in fringed edge as in fore wing. Head and thorax concolorous; shoulder slightly darker. Abdomen also concolorous with two or three transverse black stripes. Labial palpi, second segment fuscous outer edge pale, third pale with outer bar at middle. Maxillary palpi with basal half fuscous and remainder cream color. Antennæ of ground color dorsally marked with dark band at scape and at each segment. Legs concolorous, front tibiæ and tarsi barred with black, (Pl. XXVIII fig. 23). In darker specimens the front tibiæ and tarsi may be almost black, in light colored individuals the barring may be indistinct.

GEOGRAPHICAL DISTRIBUTION

According to Forbes (3), the Endotrichinæ are almost entirely confined to the Old World. So far, we only know that *Perforadix sacchari* occurs in Santo Domingo and Puerto Rico and that on the latter it is found in sugar cane fields all over the island.

FOOD PLANT

The roots of sugar cane, *Saccharum officinarum* L. is the only known food of the larva of *Perforadix sacchari.* Half grown larvæ collected in the field among sugar cane roots by the writer have however, been fed for some time on roots of *Gynerium sagittatum* (Aubl.) Beauv; bamboo, *Bambusa vulgaris,* and corn.

THE ROOTS OF THE SUGAR CANE PLANT

The work of Venkatraman and Thomas (18) on the roots of the sugar cane plant in India demonstrated the importance of a constant production of new roots for the proper development of the cane plant. These authors have shown how the cane plant under favorable conditions, constantly replaces its root system with a new one and how this constant renovation allows the plant to adapt its root system to changing conditions. When the water table is high, the root system is shallow and when the water table sinks low, the root system becomes deep. From their studies, these authors reached among others, the following conclusion: "To get a good crop the sugar cane should be given facilities for the frequent production of new roots."

Venkatraman and Thomas report a very interesting experiment in which they reproduced artificially conditions similar to those present in sugar cane plantations in Puerto Rico:

> "By a clover arrangement, originally designed by the junior author, it has been possible to grow canes away from the soil, on a definite number of roots and without any possibilities of other new roots developing. Under such conditions the plants gradually lost vigor and died out. When, however, a plant thus starved for fresh roots was given opportunities to develop them, the plant at once grew on in a remarkable manner."

And they repeat the conclusion that "the importance of a contინous development of fresh roots in the life of the sugar-cane plant is thus obvious." In the above publication the experiment is illustrated with a color plate. The drying out of the leaves and the stalks when no new roots are produced, and the immediate production of vigorous normal green shoots as soon as new roots are formed is remarkably illustrative of the conditions to be met with in Puerto Rican cane fields. In this Island the hard packed heavy soils do not allow for a constant production of new roots and in addition, the soil animals destroy them as soon as formed.

THE WORK OF THE SUGAR CANE ROOT CATERPILLAR

In most soils the majority of the roots of the sugar cane plant are found in the first twelve inches below the surface. In Puerto Rico the thing that immediately strikes the attention is that the roots are not as long as they should be for their width. If we pick them up and look at them more closely we will see that in the majority of them the tips have been destroyed, that in others the tips have been injured and that there are many neat round holes on their surface. We will discuss later the other types of injury. Let us now take up the roots whose tips have been destroyed. Those in which the injury is old may show nothing but that the tips have gone, but those in which the injury is more recent, especially if the soil is somewhat dry, will look as if the tips had not disappeared but had been mined out. When pressed between the fingers, these hollow tips feel somewhat like an empty glove finger. Obviously the central cylinder and cortex have been removed leaving nothing but the epidermis. If the soil had been moist, or if the injury were old, we could see that these bits of dead epidermis would have rotted away leaving no indication of how the injury was produced. If however, the soil is not very wet and if there are plenty of fresh roots, some may be found in which the injury is very recent and probably near to it, in the soil we will see piles of whitish excrement and may find the root caterpillar.

By digging in the soil we may not be able to find such a good specimen of the work of the root caterpillar as that shown in (Pl. XX fig. 5, A). Here the root was placed on the surface of the moist soil in a petri dish and to take the photograph after the caterpillar had performed the injury it was not necessary to disturb the root. Otherwise the delicate shell of the very tip and the silk threads which hold it in place would have been destroyed. The entrance hole at B is obstructed with a few pellets of whitish excrement. Here the caterpillar (almost full grown) entered and tunneled into the tip eating out all of its contents. How economical it is of this, the favorite food, seems to be indicated by the silk threads extending from the frail perforated shell to the soil particles as if to facilitate a most thorough consumption. This detail is very interesting when we consider that the supply of root tips is limited and that the destruction of the functional part of the roots will reduce the vigor of the plant and its capacity for further growth and further production of root tips. After tunneling out the tip, the caterpillar tunneled up the root on the other side of the entrance hole. In this upper part the epidermis being stronger required no silk reinforcement. Near to it, the piles of whitish excrement can be seen on the soil lumps. If this root had been injured in the cane fields, and the soil had been somewhat dry, the upper part of the hollow root would be the one we might find later when digging it out.

In the same Fig. is shown another root, C, not as tender and succulent as A. Here a smaller caterpillar worked making the entrance hole as before at a short distance from the tip and laying out some silk threads to hold up the shell of the tip. At D, a more mature root is shown, the tip of which had been destroyed in the field before it was placed in the dish. Here there was no tip to work on but one of the younger caterpillars tunneled in the cortex. Its pile of excrement can be seen on the side of the root near the tip. Fig. 3 in the same plate shows the appearance of such tunnels extending lengthwise like a furrow after the epidermis decays exposing them.

In the same plate, Fig. 7, shows a main root with side or branch roots. The tip of this root had been destroyed in the field before it was dug out, and as a result of the destruction of the tip succulent side roots had developed. (The three round feeding holes on the main root are not the work of the root caterpillar but of the Symphylid *Hanseniella* sp. as will be explained later.) This photograph shows again at A the typical tunneling of the thick tender root. It also shows another type of root-injury. B and C. were succulent but thin roots and a large caterpillar could not tunnel in them. It therefore ate them off and nothing but parts of the base can be seen. This is what might to called "root severing" and is very interesting as will be seen later when discussing some erroneous explanations that have been advanced by other authors for root tunneling and severing in sugar cane in Puerto Rico.

How far the caterpillar will tunnel inside the roots depends on how tender the roots are. The cortex in cane roots is thin and what the caterpillar eats is practically all the central cylinder. This becomes very tough as soon as the root begins to mature and can not be used as food. Whether the caterpillar will tunnel or eat from the outside depends on the relative size between it and the roots.

Figs. 4 and 6 in the same plate show two views of a full grown caterpillar on a root near the entrance of the tunnel at the tip. This root is somewhat mature but soft enough to be tunneled. The photographs give an idea of the comparative size of a full grown caterpillar with that of a good sized cane root.

Bionomics of Perforadix Sacchari

THE MOTH

The moths of this species usually pass unobserved. They do not leave the cane fields and seldom come to lights at night. During the day time they remain concealed in the trash on the ground and among the dead leaves hanging from the stalks of the cane plants. When startled from cover during the day by beating the trash or dead leaves, they fly back to cover again. When alighting, they run briskly and hide deeply into the trash or cracks and cavities of the soil. When caught in a net they tend to work their way out through the mesh. At dusk they leave cover and fly about. In the young cane plantations they probably fly low. In the older plantations, where the stalks are tall, and the moths more abundant, they have been observed in flight under the roof formed by the green leaves in a sort of ondulating up and down slow movement among the stalks and dead leaves hanging on them.

The moths have not been observed feeding in the field or alighting on flowers. In the laboratory when confined in vials and petri dishes they extend the proboscis and take up moisture from the soil, leaves or sides of the container. They also take up sugar and honey solutions from bits of cotton seaked in them. In cane fields, however, the moths probably take nothing else but water.

As many as 164 eggs have been laid by one female collected in the fields and kept in a petri dish with moist soil and a bit of moist cotton. The total number of eggs that each female can lay in nature is probably much greater.

THE EGG

The eggs have not been found in nature, but female moths collected in the field were confined in battery jars with moist soil. Bits of trash and cane roots were placed on the surface of the soil. After sun down the moths were observed inserting the ovipositor under the bits of trash roots and lumps of soil and into the cavities and cracks of the soil. The eggs are laid singly or in groups, usually glued to the soil, bits of trash, roots, or to each other (Pl. XXII). The shape of the eggs depends on the space in which they are deposited and how close together they are laid. When laid singly with ample room they are spherical, flattened at the poles, and with light furrows running as lines of longitude and latitude. When laid in groups in small cavities they may be bunched somewhat like grapes or even flattened almost like scales. The color is pearly. The incubation period is about 3 to 8 days in April and probably does not vary much during the rest of the year.

THE LARVA

Eggs placed on moist soil in petri dishes in the laboratory have hatched and the larvæ have been raised to adult by furnishing them with fresh tender cane roots. The very small caterpillars make very small feeding holes into the tender tissues. As they grow they take to tunneling. When tender root tips are not available, they may tunnel in the cortex of the mature roots, between the epidermis and the central cylinder. The very small caterpillars are sometimes found inside their tunnels in the cortex of the more mature roots, but only on one occasion have we found one of the larger instar caterpillars inside its tunnel in a tender root tip. These larger caterpillars remain inside the root only while feeding, living for the rest of the time in the soil cavities.

In nature, the newly hatched caterpillars probably move to the base of the cane plant where tender roots are being produced at the surface of the soil. Thence they reach the tips of the roots following the cracks and cavities of the soil. When all the root tips in one cane plant are destroyed, they seem to move to another plant. The habit of feeding above the surface of the soil on the aerial cane roots in cloudy, rainy weather, that we observed when the insect was discovered, may indicate their ability to migrate from one plant to another above ground. The caterpillars are blind and shun the light, but in cloudy weather, at night, or even during the day time, under the trash that covers the ground in cane fields they may move about freely.

The larval period lasts from 11 to 19 days at the end of which the full grown caterpillar measures 1 centimeter in length and is whitish with brown and light brown plates. (Pl. XXIII, figs. 9 and 10) and (Pl. XXIV, figs. 11–14).

THE PUPA

At the end of its freeding period, the caterpillar moves towards the surface of the soil to pupate in a cell (Pl. XX, fig. 2, A) about half an inch below the surface of the soil. The pupa (Pl. XXV. figs. 15–17) measures from 4 to 6 mm. in length. When reared in the laboratory or collected into vials or petri dishes, if a cell can not be made in the soil, the caterpillars construct a frail cocoon with silk threads and bits of soil, excrement, etc. If enough loose soil is available, the cocoon is constructed with soil particles thus creating a cell. Such cocoons may be formed in nature under the trash in cane fields but we have not found them. The point is of interest because through cultivation to keep the soil loose and preserve moisture, some control might be effected. The pupal stage lasts from 15 to 19 days and during this period the insect is very sensitive to any interference. Breaking up the cell or cocoon or any slight injury to the pupa may be sufficient to kill it.

NATURAL ENEMIES

The only insects found in nature feeding on *Perforadix sacchari* are the larvæ of a subterranean ant. This has been determined by Dr. W. M. Mann as *Cerapachys* sp. While digging in a moist clay loam, a nest of these ants was found in which an immobile and probably dead full-grown caterpillar of *Perforadix sacchari* was lying on its side, partly coiled, while several of the larvæ of the ant were hanging from its sides with their mouth parts attached to its epidermis. Ant larvæ are usually fed by the workers and this habit of directly feeding upon a caterpillar is extraordinary. We have been able to witness it on one occasion only. *Cerapachys* belong to a group of primitive subterranean ants. The condition in which the ant larvæ feed directly upon dead or paralyzed caterpillars is apparently more primitive than the feeding of the larvæ by the adult ants with regurgitated food.

Due to the habit of the adult of *P. sacchari* remaining hidden during the day time, they are safe from lizards and by flying at dusk under the leaves of the cane plant and among the stalks and dead leaves hanging from them they are also safe from bats. Spiders are the only natural enemies that may destroy a few of the adults.

SEASONAL HISTORY

The life cycle of *Perforadix sacchari* is completed in about one month and the generations overlap through the year so that the insect in all its stages may be found in any one place at any time, except in the very young plantations. The roots of the cane plants in such fields, will however be found to be injured abundantly. This is to be explained by the presence of Symphylids, bristle-tails and sow-bugs which work on the roots. When inspecting the roots, it may seem remarkable that the injury is proportionately enormous as compared with the small numbers of soil animals to be found. This will always be the case, and when the plantation is older and plenty of the work of the root caterpillar is to be found, it will also seem out of proportion to the number of insects present.

The explanation of this is that these soil animals move rapidly through the cracks and cavities of the soil and that they are small and soft and easily crushed while digging for them. They never remain close to the injury, but move on to another root-tip for their next meal. When the root-tips become scarce in one plant they move on to another. Thus they may be scarce around the roots of a plant which are practically all injured and more abundant around the fresh roots of some other plant. In judging the seasonal abundance of the root caterpillar these things must be taken into consideration. The abundance of the insect is dependent on the abundance of root tips. During moist weather, when the food supply is abundant, they will increase in numbers and cause more damage but the economic importance of the damage may be slight. With the advent of dry weather, on the other hand, the number of roots decreases and even though the caterpillars may also decrease in numbers, the economic importance of [illegible] damage increases because all of the roots may be injured or de[illegible]. Some observations seem to indicate that the caterpillars are [illegible] abundant during the dry months in the fall of the year, and t[illegible] eggs are injured by excessive moisture, but the data on this [illegible] are insufficient.

OTHER SOIL ANIMALS TO BE CONSIDERED

Besides the root caterpillar we have mentioned other soil animals which work on cane roots. It is impossible to discuss or estimate the work of the root caterpillar without discussing and estimating the work of these other soil animals which are found always associated with it. Something has to be known about them before we can distinguish between the work of one and the other and estimate the relative importance of each. Because they make cavities in the roots we may call these pests the root boring animals.

THE ROOT BORING ANIMALS

During the course of these investigations on the root caterpillar, the existence of other new root pests of sugar cane has been discovered and the nature, extent and importanc of their damage determined. These new pests have proved to be capable of injuring cane roots when isolated in vials even though supplied with moist decaying organic matter of the types found in cane fields.

The Symphylid, (*Hanseniella* sp., determined by Dr. H. E. Ewing) is the animal that makes the neat round feeding cavities or pits so common in cane roots in Puerto Rico that it is almost impossible to find a single root without them (Pl. XX figs. 3 and 7, Pl. XXI, d). The cavities are also very abundant on the roots of bamboo, *Bambusa vulgaris.* The present tendency is to consider the cortex of cane roots as unimportant and therefore this type of injury as insignificant. We know so little about cane roots that in the future this theory may change, for the cortex, if healthy, protects and nourishes the central cylinder. The pits made by the Symphylid may open the door to decay. A few of the Symphylid pits may at times be found near the root tips in the tender tissues. In these cases they are injurious and undoubtedly open the door to further damage by other soil animals or decay organism. The work of the Symphylid is of special interest to us because previous to its discovery, we naturally attributed its feeding cavities to the younger instars of the root caterpillar. This was rather annoying because the Symphylid is much more abundant than the root caterpillar and we felt quite baffled in trying to explain the enormous abundance of feeding cavities in terms of an insect which did not seen sufficiently abundant to be considered the logical cause or which at times could not be found at all. Incidentally, we have also cleared up another very interesting point, for Matz (9) in 1925 published a paper with photographs taken in Puerto Rico of feeding cavities or pits in sugar cane roots, quite similar, if not identical with those made by the Symphylid, attributing them to nematodes. This is discussed later and more fully in this paper.

The Bristle-Tails. (*Nicoletia* sp., and *Lepisma* sp.) Another cause for puzzling was the continuous finding of another type of feeding cavities or pits which are larger and not so evenly circular as those made by the Symphylid and not located in the cortex of the mature roots but at or near the tips in the tender tissues. These larger pits (Pl. XXI, e) were not the entrance to tunnels and for a time we attempted to explain them as the work of the larger root caterpillars; but this was unusual because they never developed into tunnels. They were merely feeding pits out of which the tender tissues had been scooped. They could also be found in the roots of bamboo, *B. vulgaris* and *G. sagittatum* on which the root caterpillar does not work.

A large white bristle-tail (*Nicoletia* sp.) found in the soil near the cane, bamboo and *G. sagittatum* roots was isolated in vials and found to be the cause of the larger pits. Another bristle-tail, smaller and golden-brown in color *Lepisma* sp., was also found to produce pits but this latter one is not so abundant as the former. When several bristle-tails in a vial are allowed to work on a root they may make several pits close together or even enlarge some of them, but they never make tunnels. Both bristle-tails have been determined by Dr. J. W. Folsom and are probably undescribed species.

The Sow-Bug (*Philoscia culebræ* Moore). When inspecting cane roots in the fields, sow-bugs are frequently fround in the soil among the roots and sometimes inside the root tips that have been tunneled out by the root caterpillar. Sow-bugs (undetermined) had once been reported by Van Dine (17) in 1912 from one locality in Puerto Rico as causing serious damage to cane roots but had never again been considered as possible pests of sugar cane. We have isolated them in vials with soil and decaying organic matter and found them capable of attacking the perfectly sound but tender cane roots. In doing this, they often start at or near the tip eating out irregular shallow cavities. If the sow-bugs are abundant, the cavities may be enlarged and all the surface of the tender root injured. Their injury may also start in otherwise sound roots at some feeding hole made by a Symphylid or bristle-tail in the tender tissues. The sow-bugs get into a pit and enlarge it into an irregular shallow cavity. Inside the tunnels made by the root caterpillar, sow-bugs may continue the injury or merely feed on the decaying epidermis. In the field, sow-bugs are usually found near the surface at the base of the cane stool but it is difficult to determine how much they are feeding on decaying organic matter and injured roots and how much on the tender newly produced roots.

This species has been determined for the writer by Dr. J. O. Maloney of the Division of Marine Vertebrates, U. S. National Museum. It was originally described by H. F. Moore (10) from two specimens collected under drift on the shore on Culebra Island, P. R. Moore's description has been copied by Dr. Harriet Richardson (11) in her Monograph of the Isopods of North America.

THE OLD ROOT PESTS

The White Grubs. There are several species of white grubs (*Phyllophaga*) and the larvæ of the rhinoceros beetle, *Strataegus titanus,* which attack the roots of sugar cane in Puerto Rico. The rhinoceros beetle larvæ are not common, but the *Phyllophaga* species are found all over the Island and at certain times in some localities are quite abundant and injurious. This is especially true of some localities in the South Coast of the Island. Through the rest of the Island they are always to be met with when digging out cane roots, but ordinarily they are not sufficiently abundant to become important, and many plants will always be found that have not been injured at all by white grubs. The white grubs eat off the roots. They may sever them, or, beginning at the tip, keep on eating until the tender parts are consumed. The injury when not fresh may resemble the work of the root caterpillar, but when fresh there can be no mistake. In the first place, if white grubs are the cause of the injury, they will be found near the roots (they take about nine months to develop and moved very slowly through the soil). In the second place white grubs can never produce the emptied out root tips characteristic of a root-borer, nor do they produce the piles of whitish excrement. The root caterpillar is found in more or less the same abundance throughout the Island, while white grubs are abundant sporadically and in restricted localities. Very frequently, the work of the root caterpillar (and the other root boring animals) will seem the only possible explanation for the drying out of the cane when no white grubs or indication of white grub injury is to be found. In such situations the roots may be long and apparently normal, but upon close examination the tips will be found to have been destroyed or injured.

The Nematodes and Other Organisms. It is well known that nematodes work on the roots of sugar cane in Puerto Rico causing the characteristic hypertrophies or "clubbing". They are, however, found only in light sandy soils or in light soils with a very porous subsoil and seldom if ever in the heavy clay loams which constitute a considerable percentage of the soils of the Island. Furthermore, even in the light soils, nematodes are ordinarily of little or no economic importance in Puerto Rico.

Matz (9) who studied "root disease" at the Insular Station of Puerto Rico from 1919 to 1922 and then continued his studies in the South Coast of the Island, attempted to explain the feeding cavities or pits found so commonly in sugar cane roots in terms of nematodes. In doing this, Matz's method was purely speculative for apparently he never reproduced the injury experimentally under controlled conditions. He also admits these two contradictory facts: (1) that the pits are found in cane roots commonly all over the Island in the heavy clays as well as in the light sandy soils, and (2) that nematodes seldom if ever occur in heavy clay soils.

But, if pits in cane roots are found all over the Island in all types of soils, the causative organism can not be of limited distribution. The animal which makes the pits must necessarily occur in all types of soil and be proportionately abundant to the amount of injury. The Symphylid, *Hanseniella* sp., answers these requirements. It can be found easily in any cane soil and will produce neat round pits in the cortex of perfectly sound cane roots in vials in the laboratory.

Similar pits are common in sugar cane roots in Louisiana. Matz mentions in his paper that in Louisiana snails were considered to be the cause of the pits. Recently, in 1927, Spencer and Stracener (14) have demonstrated experimentally that the pits in Louisiana are made by the Symphylid, *Symphylella* sp. A comparison of the photographs of the pits in cane roots caused by the Symphylid *Symphylella* sp., in Louisiana with those attributed to nematodes by Matz in Puerto Rico and with Pl. XX, figs. 3 and 7 and Pl. XXI, d in this paper will show their close similarity.

According to Matz, the gravid females of a nematode living in the cortex of the cane roots caused the cavities or pits which could not become noticeable until the epidermis rotted and the nematode abandoned the cavity. But the pits are frequently to be found near the tender tips in tissues so young that Matz's explanation would be untenable. Thus it seems quite evident that Matz was mistaken in attributing the pits to the work of nematodes. Credit is due to him, however, for having been the first to observe, report and publish photographs of pits in sugar cane roots in Puerto Rico.

The Weevil Root-Borer. The work of the larvæ of *Diaprepes spengleri*—tunneling in the underground parts of the stem or root stalk—is common in certain localities, especially on the South Coast of the Island and the insect is very well known to all. Its common name, however, is inappropriate although very interesting to us because it indicates that those who named it were familiar with a type of root injury—tunneling—which they considered important but the cause of which was unknown. Apparently, in suggesting *Diaprepes* as the cause they were giving it the benefit of the doubt. Thus it has been called the "sugar cane weevil root-borer" or the "root-borer of sugar cane". These terms erroneously convey the idea that there was known at that time some other root-borer of sugar cane not a weevil from which it had to be differentiated, besides leading one to believe that the ability of *Diaprepes* to tunnel or bore in cane roots is a proved fact when actually it is nothing more than a supposition. No one has ever found the larva of *Diaprepes* boring or tunneling in cane roots or determined this ability experimentally. The adults, of course, leave the soil as soon as they transform and practically never eat cane leaves preferring those of bushes and trees on which the eggs are laid glued between two leaves. According to Jones (7):

> "The larvae apparently do not enter the large root-stalks of the cane until some time after issuing from the eggs. During the intervening time they probably feed upon the smaller roots, and it is possible that they do not require living roots altogether, but subsist in part upon decaying vegetable matter. Later they enter the root-stalks making tunnels therein."

The root troubles or "root disease" of sugar cane have been the subject of investigation ever since the Insular Experiment Station became established in 1910. Investigators of world wide reputation such as Van Dine, Van Zwalluwenburg, Smyth, Wolcott, Johnston, Stevenson, Matz and Earle studied the problem most intensively. Up to the present, there has never been one record of the larvæ of *Diaprepes* found tunneling in cane roots. There is a possibility that if they were responsible for all the tunneling one finds all over the Island, at least one specimen would have been found directly associated with the injury. Instead, we sense in reading their work that all these investigators were continually meeting with types of root injury, (pitting, pruning, severing and tunneling) which they could not attribute to any known organism. Hence the name "weevil root-borer" for *Diaprepes* when it should have been more properly called "root-stalk borer".

As late as 1919, we still find Smyth (13) explaining root tunneling in terms of *Diaprepes* which he calls the "sugar cane root-weevil" without having found the larvæ doing the damage in the fields or reproducing it experimentally in the laboratory.

The Root Mite. In the same year, Smyth (13, 14) reported the mite, *Uropodus* sp. with the common name of "sugar cane root mite" stating that this animal:

> "Eats into, severs, and sometimes tunnels the roots. Damage sometimes serious. This pest was first noted in the Arecibo district . . . and has since been found abundantly at Río Piedras and in other districts. Its damage arises from its attack on the roots which in some cases it tunnels and severs to a considerable degree. Although . . . the roots showing its injury are in many cases diseased and partly decayed, it has been found attacking also healthy roots, so in some cases is believed to be the primary cause of root decay."

Apparently what Symth found was the unknown injury and some mites associated with it, but nothing in Smyth's paper indicates that he ever attempted to reproduce the injury experimentally. In attempting to test whether this or any other mite found associated with cane roots could injure them, the first and main difficulty we have met is the scarcity of the mites. One or two could be found once in a while, but never in sufficient abundance and in constant association with the fresh injury to make them suspicious of it. The very few found associated with decaying roots were not determined, but when isolated with tender sound roots in vials they did not injure them. As an explanation of why they are found occasionally among cane roots Smyth himself in that same paper referring to the *Uropodus* mite, writes: "This animal belongs to a group of mites which possess the habit of attaching themselves to beetles as means of transportation and distribution." Since *Phyllophaga* and *Strataegus* as well as *Dyscinetus* beetles are found in the soil among sugar cane roots where they hide or go to oviposit, this might suffice to explain why the mites are found occasionally in the same situations. It does not necessarily follow however that they are injurious to the roots. As a matter of fact they have sometimes been considered beneficial when apparently attacking larvæ, pupæ and eggs of *Phyllophaga* and *Stratægus*. They might also possibly attack the root caterpillar.

DISEASES WHOSE SYMPTOMS MIGHT BE CONFUSED WITH THOSE OF ROOT INJURY

Gummosis and Dry Top Rot. Gumming disease or gummosis is caused by *Bacterium vascularum* and dry top disease is caused by *Ligniera (Plasmodiophora) vascularum* (Matz) Cook. In both diseases the vascular bundles are obstructed by the causative organisms and the products resulting from their activities. This prevents the water and plant food elements from reaching the leaves and the elaborated foods from moving downwards from the leaves into the stalk and roots. The symptoms above ground are the drying out of the leaves, the dying out of the tops and the final drying and dying of the plant. These symptoms might be confused with those of root injury but the existence of the two diseases can easily be determined in most cases. In the first place, some varieties are immune to both diseases and dry top rot is found only in wet soils. In the second place cross sections of the bases of the stalks will show in the case of gummosis the yellow exudations of gum from the bundles, and in the case of dry top rot the orange color of the bundles characteristic of each of the two diseases.

Root Disease. The symptoms of root disease in the stems and leaves would be the same as the symptoms from root injury produced by soil animals and quite similar also to the symptoms of gummosis and dry top rot since in either case the plant suffers because the circulation of water and soil solutions is affected or checked. Root disease is supposed to be caused in Puerto Rico by species of *Pythium* and *Plasmodiophora.* Matz (8) at the Insular Experiment Station was able to destroy healthy cane roots by inoculations with pure cultures of these fungi, but in the field they are supposed to be facultative, that is, able to attack the cane roots only when injured by soil animals or weakened by adverse soil conditions. Apparently an experiment has never been conducted in Puerto Rico in which all the symptoms which are supposed to be those of root disease have been produced by inoculations with pure cultures of any fungi under conditions in which the soil animals have been eliminated. When one goes through the work of the early plant pathologists of the Insular Experiment Station, such as Johnston and Stevenson, and of the entomologists such as Van Dine and Van Zwaluwenburg it is very interesting to notice now the former considered fungi the main cause of "root disease" while the latter insisted on the importance of soil animals. Now that we know more about the animals that injure sugar cane roots and of the facultative nature of the fungi which can cause root disease, we realize that possibly the entomologists were nearer to the truth than the plant pathologists. The only experiment conducted in 1920 at the Insular Experiment Station by Matz (8) to prove that fungi could produce the condition known as "root disease" proved on the contrary that there was no difference between his inoculated plants in pots and the checks until they were set out in the fields, harvested at maturity and allowed to ratoon. Then, those of the ratoons that showed stunting, drying out of the leaves, etc., happened to be in "a very compact soil." We can see how root pests whose injury may become the limiting factor in compact soils might have complicated Matz's experiment since no precautions were taken to eliminate them. Matz himself admits that: "This unevenness was no doubt due to soil conditions, as the effect of the previous inoculations were entirely lost during the first season of growth after the transplanting to a new location."

THE POSSIBILITIES FOR THE CONTROL OF THE ROOT-CATERPILLAR

SOIL FUMIGANTS

Wolcott (15, 16) has investigated the use of paradichlorobenzene, calcium cyanide and the carbon bisulphide fish oil emulsion recommended by Leach and Thompson for the Japanese beetle, for the control of white grubs in Puerto Rico and found that the first two fumigants kill only a low percentage of grubs and are quite expensive. The bisulphide emulsion kills a high percentage but its cost is also prohibitive and the mode of application by means of a hose or some such arrangement is impractical.

We have made several tests with the carbon bisulphide emulsion. In metal drums it gave an almost complete control of all root pests when applied to the moist soil at the rate of 6cc of the diluted emulsion per square foot of soil. The only possibility of using it would be in cane under irrigation by applying the fumigant with the irrigation water, but it is questionable if this would be practical.

According to Jarvis (6) paradichlorobenzene and carbon bisulphide are used in routine field practice in Queensland for the control of white grubs. We have tested these two fumigants in cane fields on the Station grounds making the applications in the manner and using the largest doses recommended for Queensland attempting to kill all root pests found in Puerto Rican soils, but with complete failure. The soils to which the fumigants were applied may be considered representative of the average on the Island. At different intervals up to two weeks after the applications were made, perfectly healthy white grubs, root caterpillars, Symphylids and bristle-tails were to be found within six inches from the points of application. The fumigants do not diffuse as readily through the soils of Puerto Rico as they do through the soils in Queensland. We have not tested calcium cyanide, but it will also be difficult for this fumigant to diffuse through the hard packed soils.

CULTUREL PRACTICES

Starting from the point that sugar cane will produce satisfactory yields when the soil conditions are favorable even in spite of the injury caused by root pests, it logically follows that when the soil conditions are unfavorable they must be corrected before any other measure of direct control can be contemplated. In all the work of the late Professor Earle on "root disease" (1) and sugar cane culture (2) we find constant reference to the need of keeping the soil in cane fields loose and permeable. When we go through the history of the sugar cane industry in Puerto Rico we find that the loss of organic matter and the resulting bad physical and chemical condition of the soils has been a constant source of trouble, and that the condition we know as "root disease", "root disease complex" or "growth failure complex" is nothing new.

In the beginning, all that was necessary was to make a hole in the virgin soil, plant the seed pieces of the "Criolla" or "Otaheiti" cane and keep down the weeds with the hoe to get crop after crop from the same planting. But gradually, the organic matter content of the soil decreased and in 1872 we hear of an epidemic, a "disease" of the cane plant in which isolated stools or patches throughout the plantations, dried out and died. We have careful reports published at that time of the symptoms and they are exactly those of root injury that we have been discussing or those that Earle gives for "root disease." We have also very careful reports of the observations and the experiments made at that time to determine the possible cause of the trouble. We known that although a few white grubs were observed, they were not abundant enough to be considered the cause. It is also recorded that sections of the stalk taken up into the mountains and planted where no cane had grown produced normal plants and that sections from their stalks when taken back again to the original soil produced "diseased" plants. The conclusion logically reached at that time was that the origin of the trouble was in the soil and not in the cane plant and it was noted that for some reason the root system of the cane varieties grown—the "Criolla" or "Otaheiti" which once produced good yields were no longer suitable for the soil

The cane had not changed, but the soils had. They had lost much of their organic matter. Due to their high organic matter content, the virgin soils were rich, porous and retentive of moisture. In them the "Otaheiti" cane with its shallow and weak root system could find sufficient food and could make up by a constant production of new roots the damage caused by soil animals. As the soil began to loose its good chemical and physical conditions the cane began to suffer. It was not until 1872, however, that the trouble was felt when it became so abundant as to affect the sugar cane industry of the whole Island.

Apparently the situation was remedied for some time by the introduction of new Oriental cane varieties with stronger and deeper root systems. In 1910, when the Insular Experiment Station was established, the first plant pathologists and entomologists immediately focused their attention on the "root disease" of sugar cane as of fundamental importance. With the introduction of sugar cane mosaic disease into Puerto Rico, from 1915 to 1919, the center of interest changed to the new disease, but with mosaic under control, by 1919, the investigational interest goes back again to "root disease." Earle (1) wrote in 1920, as follows:

> "This trouble is always with us. There is not a cane field in the Island that is not more or less affected by it. It is the cause of the dying out of the cane in so many fields that necessitates such frequent replantings. If it were not for root disease we would be to-day cutting twenty or thirty ratoon crops from each planting of cane as was done in the early days of the cane industry of this Island, and is still being done on virgin lands in eastern Cuba and in Santo Domingo. The expense of these frequent replantings is by no means the only loss caused by root disease. It is safe to say that one form or another of the troubles known under this collective name is causing a loss

of tonnage on every acre of cane now growing in Porto Rico. Few cane planters who really understand these facts will question the statements that this is by far the most serious problem that confronts the cane grower not only in Porto Rico but on old lands in all parts of the sugar cane growing world."

Earle condemns the practice of planting cane in holes as in the early days of the industry and recommends the destruction of weeds through cultivation instead of the hoe, to keep the soil in good tilth and save moisture. He compares the growing of sugar cane, a crop requiring enormous amounts of water during all its life, and without cultivation in the most compact of soils as done in Puerto Rico, with the growing of cotton, a plant which does not require much water and for a short period only, with cultivation in loose soils in the United States. We can not take up all the recommendations made by Earle (2) intended for keeping the soil loose and moist and inducing a vigorous, abundant and deep root system, but we can quote the more important ones:

"Used with good judgment, proper drainage, abundant fertilizer and frequent tillage will prevent nineteen-twentieths; yes, ninety-nine hundredths of the cases of 'root disease' and at the same time will so increase yields that they will prove a decided economy and not an expense."

We might add that if the dead leaves were removed from the stalks and the trash buried if possible during cultivation, the moths of the root-caterpillar would be deprived of cover. This would tend to restore the organic matter and produce the conditions under which the plants can make up for the damage caused by the insect. Frequent cultivation might also reduce the insect by destroying many of the pupæ and some of the caterpillars. If to this were added the growing of legumes to be plowed under instead of allowing the land to lie fallow and the cane stubble to die out gradually to be replaced by grasses, this would further increase the fertility, and organic matter, and help to control the root-caterpillar, other soil animals and the grasses.

If Earle's recommendations are desirable to control or prevent root desiase, now that we know how the root caterpillar and other new root pests work and affect the sugar cane plant, the same recommendations should be even more desirable. We may, through breeding and selection produce cane varieties with deeper and stronger root systems as Venkatram and Thomas (18) recommend and indeed this is very advisable, but we should first of all correct the soil conditions keeping in mind another of the recommendations made by these authors, namely that: *"To get a good crop the sugar cane should be given facilities for the frequent production of new roots."*

SUMMARY

1. A root-boring caterpillar has been found in Puerto Rico in the soil around sugar cane roots which has been named the sugar cane root caterpillar, *Perforadix sacchari* new genus and species (Pyralididæ, Endotrichinæ). It had been previously reported as *Sufetula grumalis* Schaus (Pyralididæ, Pyraustinæ) and specimens under that name from Puerto Rico and Santo Domingo are to be found in the collection of the U. S. National Museum in Washington.

2. In captivity, the larvæ will also feed on the roots of corn, bamboo and *Gynerium sagitattum*, but in nature no indication of the work of this insect has been found on the roots of these plants.

3. In the early instars the caterpillars feed on the very tender roots or in their absence may tunnel in the cortex of the mature roots of sugar cane. The later instar caterpillars tunnel in the thick succulent tips of the tender roots.

4. The damage is cumulative. As the plantation grows older the number of caterpillars and the amount of injury increases. The injury may not show above ground but probably it causes always some reduction in yield and shortens the duration of the plantation. Upon the advent of dry weather and when the soil conditions are unfavorable for the production of new roots, the destruction of the root-tips may become in some localities the limiting factor in sugar cane growing.

5. The distribution of the caterpillars is not uniform in any plantation, and furthermore they seem to migrate from one plant to another in search of fresh root tips. As the soil also varies within any particular field, the root injury showing in the parts of the plant above ground, is not uniform. Scattered stools or patches of stools will dry out while the rest of the plantation may be uniformly green.

6. As a rule, when the soil conditions are proper for the sugar cane plant, although the injury to the roots may be abundant, it does not show above ground.

7. The root injuries produced by the younger caterpillars may be confused with those produced by other soil animals, but the tunneling in the larger roots made by the older caterpillars and the piles of whitish excrement thrown out of them are characteristic and unmistakable.

8. Soil fumigants have so far proved impractical, but the cultural practices recommended by Earle for "root disease" would make it possible for the plants to keep up a constant production of new roots and to produce satisfactory yields in spite of the injury caused by the root caterpillar.

9. Other new root pests of sugar cane whose injuries are found associated with those of the root caterpillar are the Symphylid, *Hanseniella* sp., the bristle-tails, *Nicoletia* and *Lepisma* spp., and the sow bug, *Philoscia culebrae* Moore.

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EXPLANATION OF PLATES

PLATE XX

Fig. 1. Adult female of *P. sacchari* enlarged.

Fig. 2. A, empty pupa cell of *P. sacchari;* B, newly emerged adult; C, empty pupal skin.

Fig. 3. Tunnel of small *P. sacchari* caterpillar extending full length in cortex of root after the epidermis has decayed exposing it; A, side roots with pits made by the Symphylid. *Hanseniella* sp.

Fig. 4. Full-grown *P. sacchari* caterpillar on large sized sugar cane root near entrance of tunnel which is surrounded by piles of excrement.

Fig. 5. The work of the root-caterpillar in sugar cane roots: A, a perfect tunnel with the shell of the root tip held up by silk threads; B, the entrance hole to the tunnel obstructed with pellets of excrement; C, a smaller root whose tip was not as succulent as in A tunneled by a smaller caterpillar: D, a mature root in the cortex of which a small caterpillar has tunneled showing piles of excrement on the side of the root; E, edge of petri dish.

Fig. 6. Same as 4, a different view.
Fig. 7. A good sized sugar cane root whose tip had been destroyed and which had produced side roots. A, entrance hole in tunneled root; B and C, severed roots of which only parts of the base are left attached to the main root; the three round holes in the main root are the work of the Symphylid, *Hanseniella* sp.
Fig. 8. A group of eggs of *P. sacchari* deposited on a cane root that lay on the surface of the ground.

PLATE XXI

Illustrations of work. A, C, D, E, F, G, old injuries; B and H, recent injuries. a, entrance hole of tunnel; b, piles of excrement, c, emptied out region of root tips; d, pits made by the Symphylid *Hanseniella* sp. e, the work of bristle-tails and possibly also sow-bugs.

PLATE XXII

Eggs greatly enlarged. A, C and D, sketches showing grouping as laid; B, E, F and G, eggs as laid singly. E and F lateral views, G, dorsal view.

PLATE XXIII

Fig. 9. Larva, dorsal view.
Fig. 10. Larva, lateral view.

PLATE XXIV

Fig. 11. Seta-map.
Fig. 12. Labrum, greatly enlarged.
Fig. 13. Head and cervical shield, dorsal view.
Fig. 14. Head, cervical shield and pro-thorax, lateral view.

PLATE XXV

Fig. 15. Pupa, dorsal view.
Fig. 16. Pupa, ventral view.
Fig. 17. Pupa, lateral view.

PLATE XXVI

Fig. 18. Fore wing.
Fig. 19. Hind wing.
Fig. 20. Variations in the length of the stalking of R_5 with R_3 and R_4 and origin of veins from cell.

PLATE XXVII

Fig. 21 *a*. *Diplopseustis minima*, head, side view.
Fig. 21 *b*. *Perforadix sacchari*, head, side view.
Fig. 22. *P. sacchari*, head, anterior view, partly denuded with details of antennae and maxillae.

PLATE XXVIII

Fig. 23. Fore leg.
Fig. 24. Middle leg.
Fig. 25. Hind leg.

Cl, Claw; Cx. coxa; Ep, epiphysis; F. femur; Pv. pulvillus, Sp, spurs; Tar, tarsus; Tb, tibia; Tr, trochanter.

PLATE XXIX

Fig. 26. Female genitalia, latero-ventral view; Oo, ovipositor; Ov, opening of vagina.
Fig. 27. Tip of ovipositor with egg ready to be laid, dorsal view.
Fig. 28. Male genitalia cut through left valve and opened out.
Fig. 29. Male genitalia, ventral view.
Fig. 30. Inner face of valve, more enlarged.

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PLATE XX

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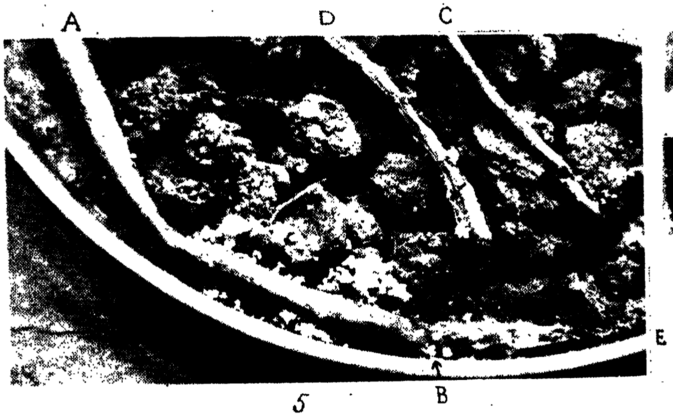

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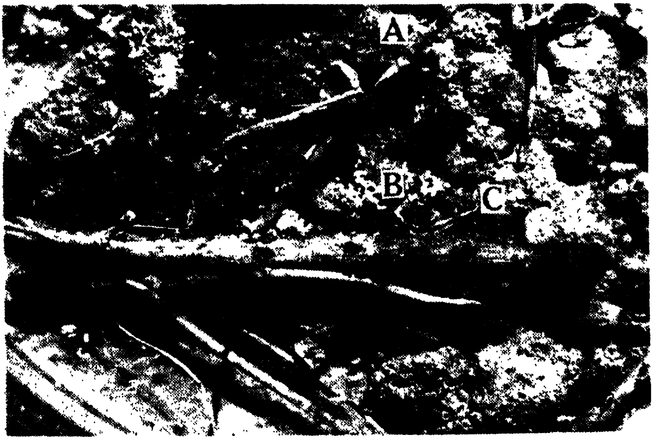

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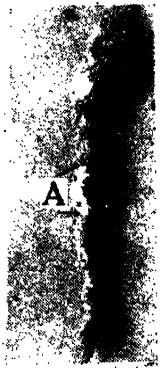

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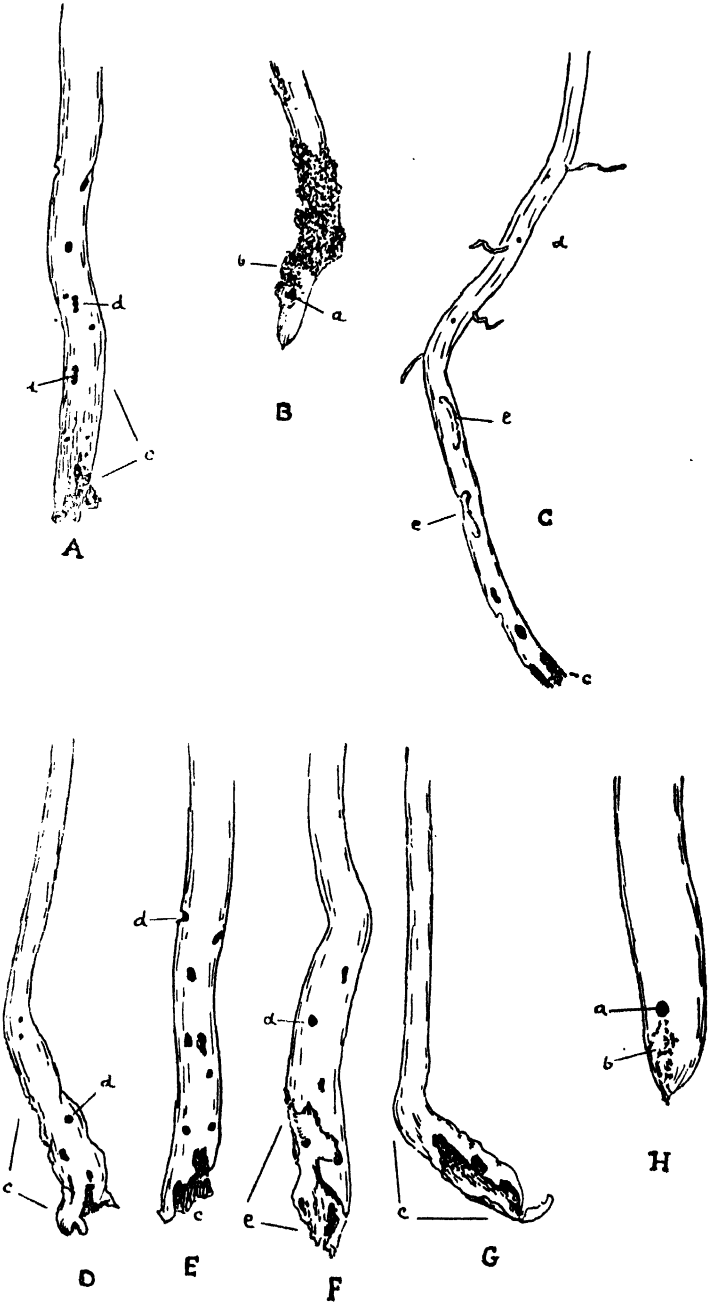
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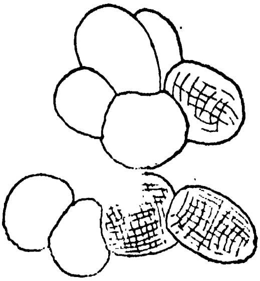

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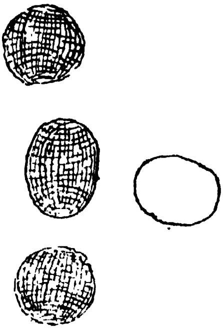

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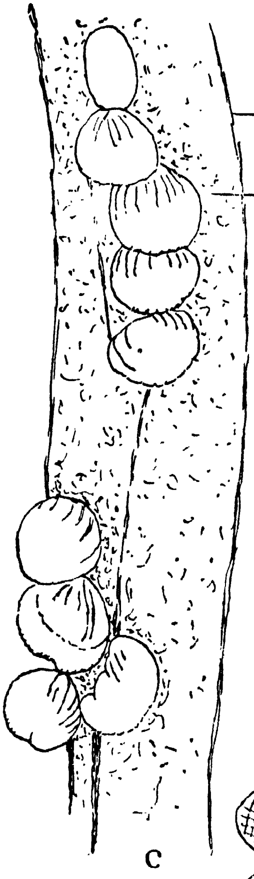

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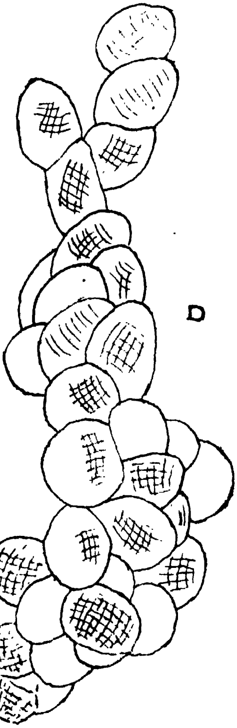

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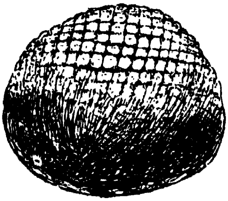

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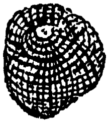

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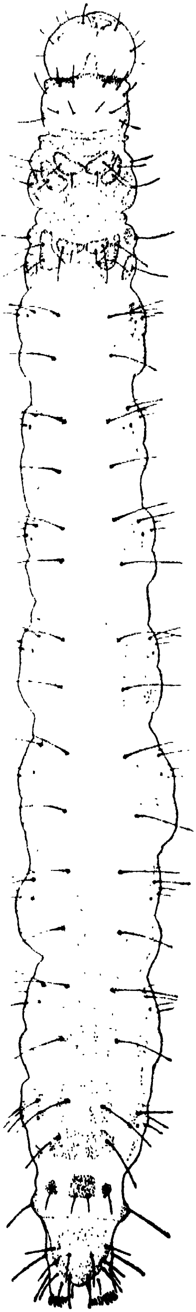
PLATE XXIII



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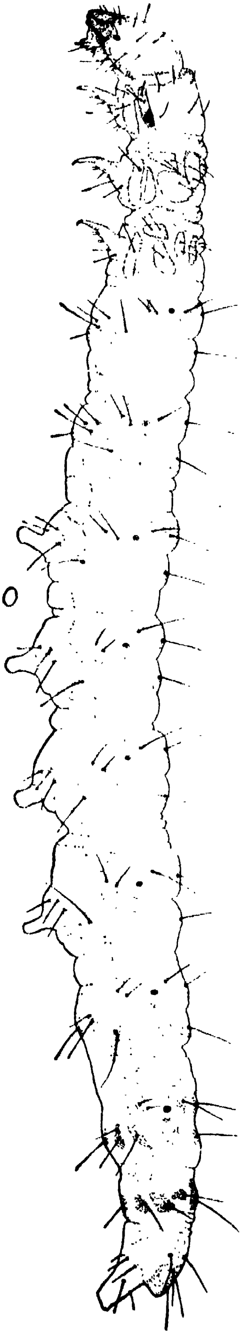

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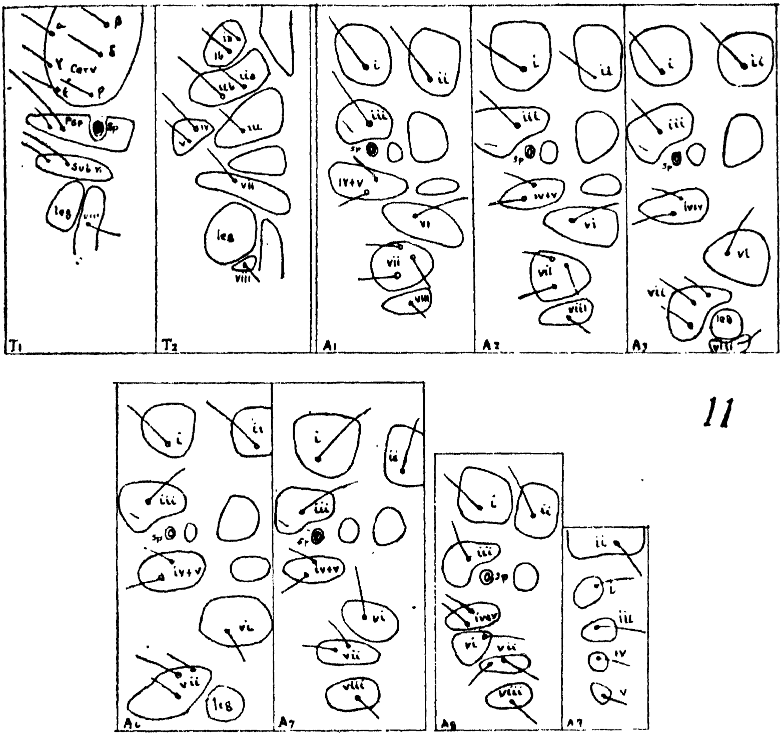
PLATE XXIV



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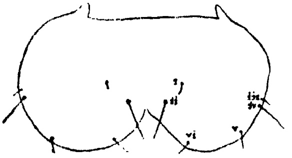

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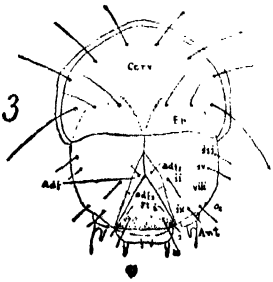

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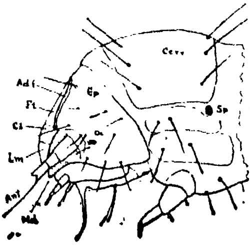

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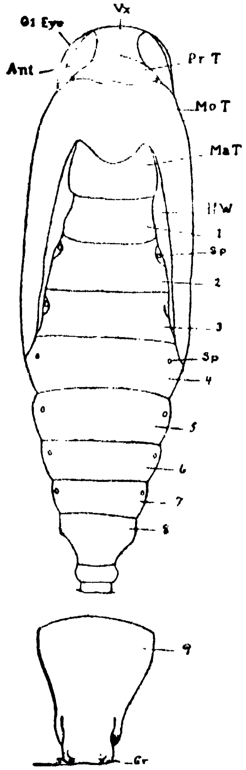

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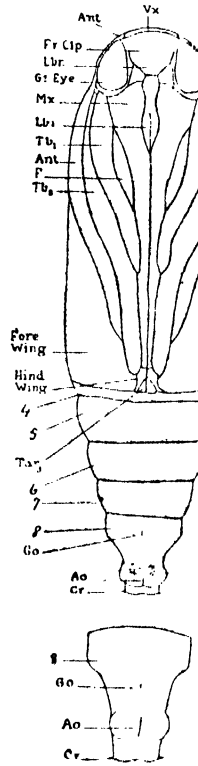

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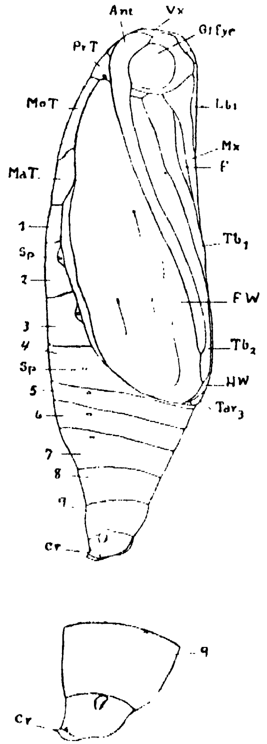

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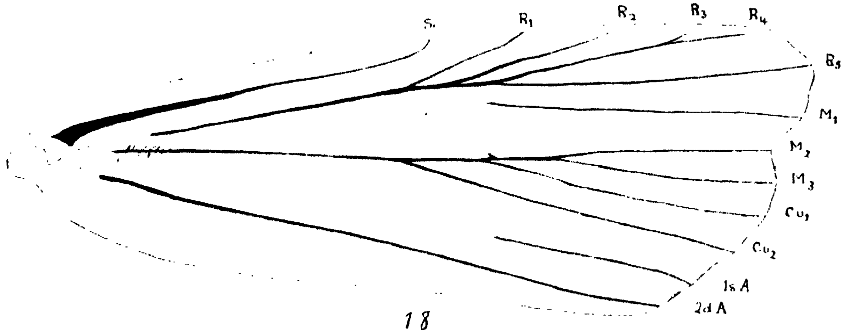

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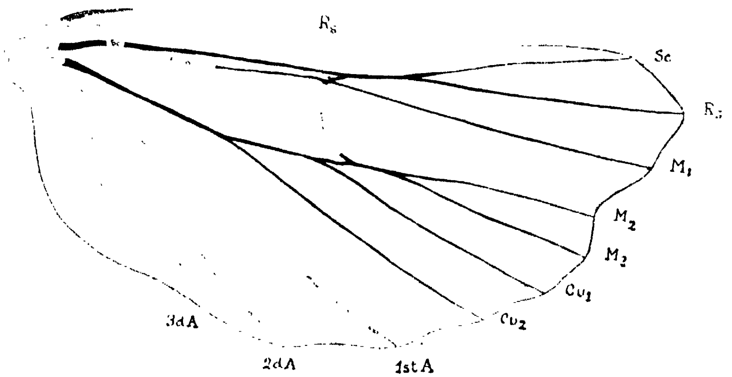

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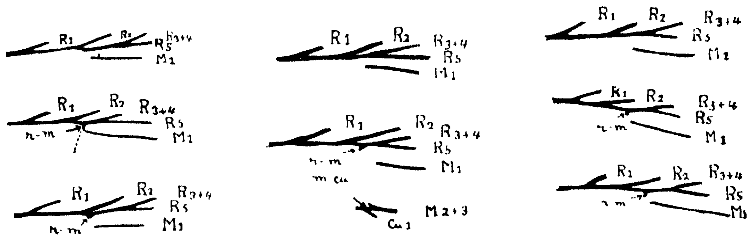

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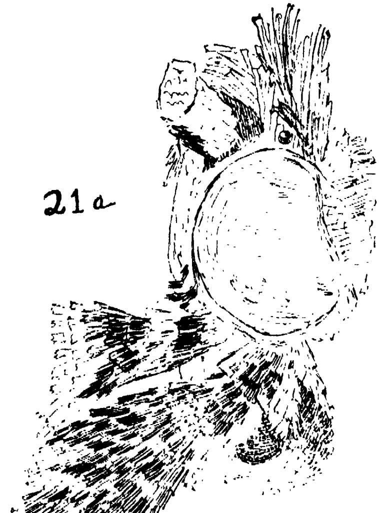

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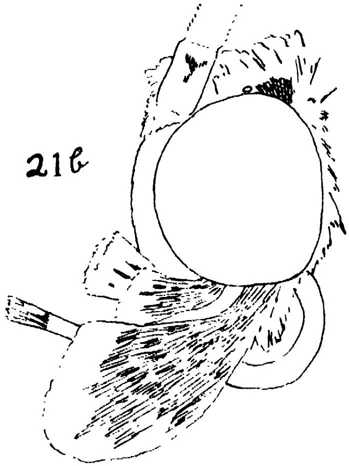

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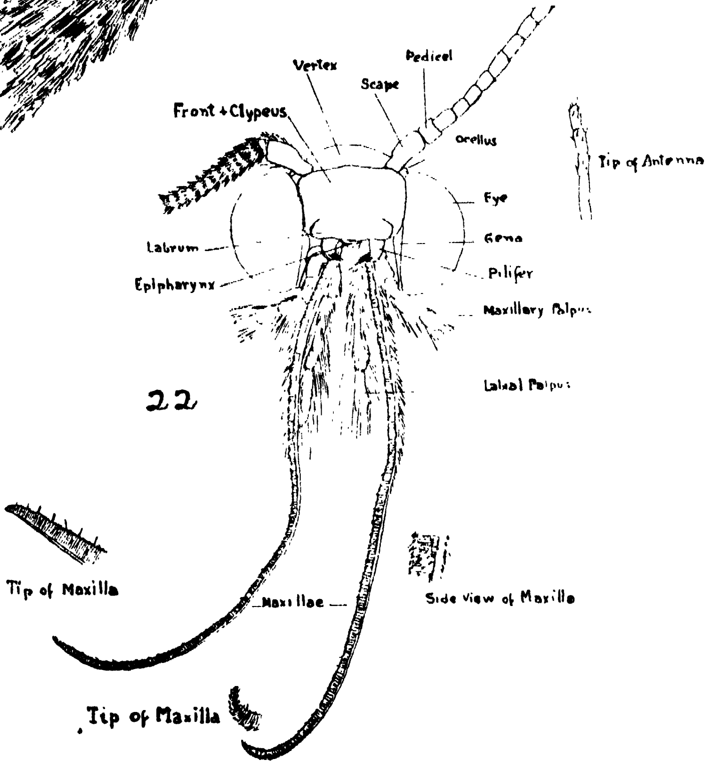

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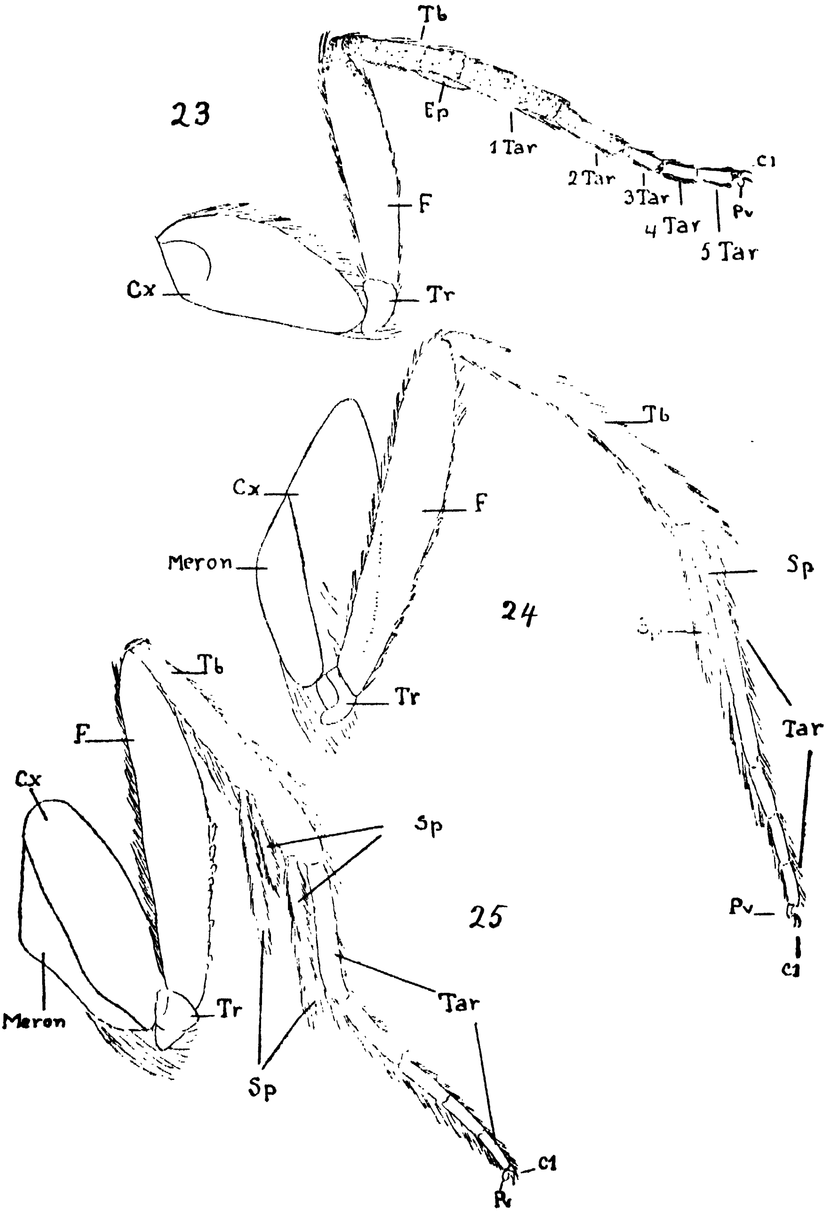
PLATE XXVIII



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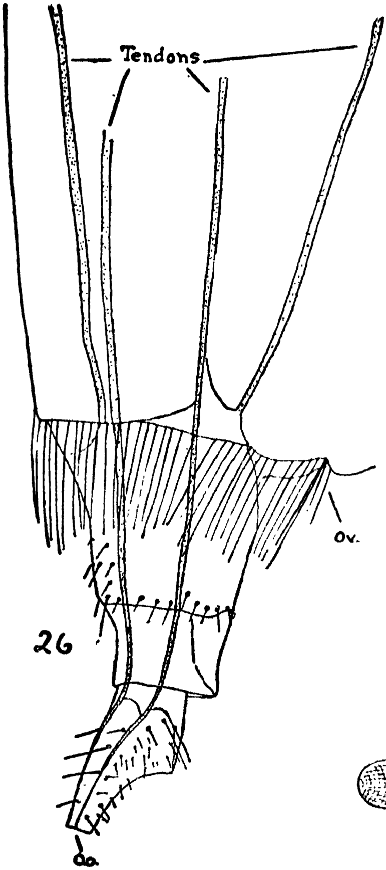

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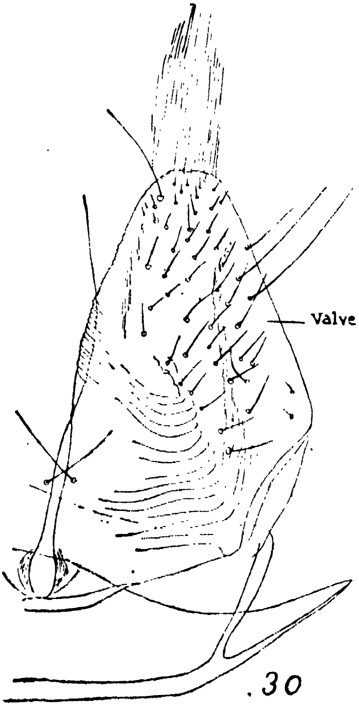

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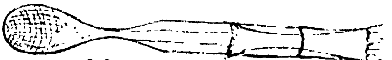

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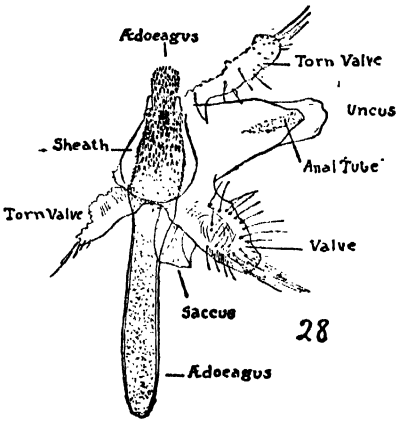

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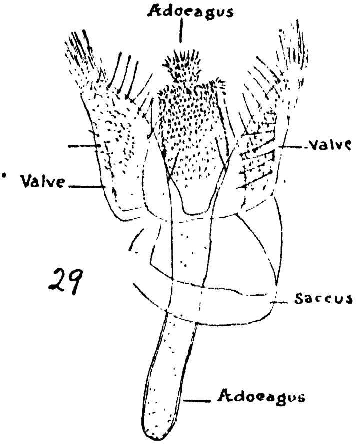

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THE JOURNAL
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DEPARTMENT OF AGRICULTURE
of **PORTO RICO**

MELVILLE T. COOK, Editor.

MYCOLOGICAL EXPLORATIONS OF COLOMBIA

CARLOS E. CHARDON and RAFAEL A. TORO.

with contributions on

MYXOMYCETES—W. C. Muenscher; **PHYCOMYCETES**—W. H. Weston;
PEZIZALES—F. J. Seaver; **XYLARIACEAE**—J. H. Miller;
CERCOSPORAE—C. Chupp; **USTILAGINALES**—H. S. Jackson;
UREDINALES—F. D. Kern and H. H. Whetzel;
EU-BASIDIOMYCETES—L. O. Overholts;
and a **HOST INDEX**.

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VOL. XIV OCTOBER 1930 No. 4

MYCOLOGICAL EXPLORATIONS OF COLOMBIA.

CARLOS E. CHARDON and RAFAEL A. TORO

The scope of the present paper is to bring up to-date our present knowledge of the fungus flora of Colombia, by reviewing the literature on the subject, followed by a critical study, in collaboration with various specialists, of collections made by the authors during the years 1926-29, and the preparation of a preliminary host index. It would be pretentious for the writers to attempt to cover the entire field of systematic mycology of such a vast and little explored country as Colombia, with such varied topographical and climatological features which explain its enormously rich flora. All that may be accomplished here is to more or less superficially cover some groups of fungi, in an attempt to make this paper a starting point for the study of the fungous flora of Colombia, which may be helpful to students subsequently interested in the subject. A few species from Panamá, collected by the senior writer, are also included in this paper.

The senior writer became interested in Colombia in 1926. At the invitation of the governor of the department of Antioquia, a visit was made to Medellin, to reorganize the "Escuela Superior de Agricultura y Veterinaria". This first trip is shown in the enclosed map (Fig. I). Landing at Puerto Colombia early in April, the ascent of the Magdalena River, from Barranquilla to Puerto Berrio was made in an airplane in a few hours time. Next day Medellin was reached by rail, after crossing the Central Andes at La Quiebra, and approximately two months were spent in that city in the reorganization of the agricultural school. A few excursions were made in the vicinity of Medellin and adjoining towns with the purpose of collecting fungi and a 5-day excursion on mule back (May 25-29) was made across the rich coffee section of Fredonia striking the Cauca River at Bolombolo. This last trip was very interesting and fruitful in botanical collections. On the way back to the coast, the trip down the Madgalena was made on one of the river boats, and a little collecting was done along the banks across Puerto Berrio, Barranca and Puerto Wilches. The return to Porto

Rico was effected the last week in June. A total of 172 numbers of fungi were collected in this first trip.

The junior writer arrived in Colombia in January 1927 and held the professorship of botany and plant pathology at the Agricultural School in Medellin until December 1928. Opportunities for collecting flowering plants[1] and fungi were plentiful, in the vicinity of Medellin, in the coffee section of Fredonia and Angelópolis (Central Andes) and in Salgar, beyond the Cauca River in the Western Andes. This last region, previously unexplored by botanists, proved to be of unusual interest. In December 1928 he was transferred to Bogotá as plant pathologist for the Ministry of Industry, a position which he held until March 1930. Being tied up with regulatory and administrative work, but little attention could be given to collecting, but a number of specimens were picked up in the Sabana de Bogotá and in Duitama, Boyacá. During October 1929, a trip was made to Tumaco and Pasto in the frontier department of Nariño. A total of 360 fungus collections were made by the junior writer.

In 1929, a second opportunity to visit Colombia was afforded to the senior writer, through an invitation from the Governor of the department of Valle del Cauca, to visit that state as the head of a commission to undertake an agricultural survey of the Cauca valley and organize an experiment station in Palmira. Mr. J. A. B. Nolla, of the Insular Experiment Station of Porto Rico, accompanied the expedition as plant pathologist, and was a very helpful collaborator in picking up parasitic fungi. The party left San Juan, P. R., on April 23, 1929, and arrived at Cristóbal, C. Z., on the 26th. A few days were spent in Panamá waiting for steamer connections. Traveling facilities were kindly supplied by Dr. Antonio Díaz, of the Department of Agriculture of Panamá, and several trips were made: one extending to the west as far as Aguadulce and the other, in company with Dr. James Zetek, to the interesting Barro Colorado Island in Gatún Lake. Our collecting in Panamá was rather scant due to the prevalent drought, but some interesting species were collected.

On May 5, the party sailed from Balboa and arrived at Buenaventura on the 7th. The Pacific coast of Colombia is exceptionally humid, an average precipitation of 360 to 380 inches annually being reported in Buenaventura. The coast is heavily forested and offers very rich collecting grounds for the naturalist. On the 9th our party crossed the Western Andes by rail and arrived at

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[1] Over 1,300 specimens of phanerogams were collected and sent to Dr. N. L. Britton, New York Botanical Garden.

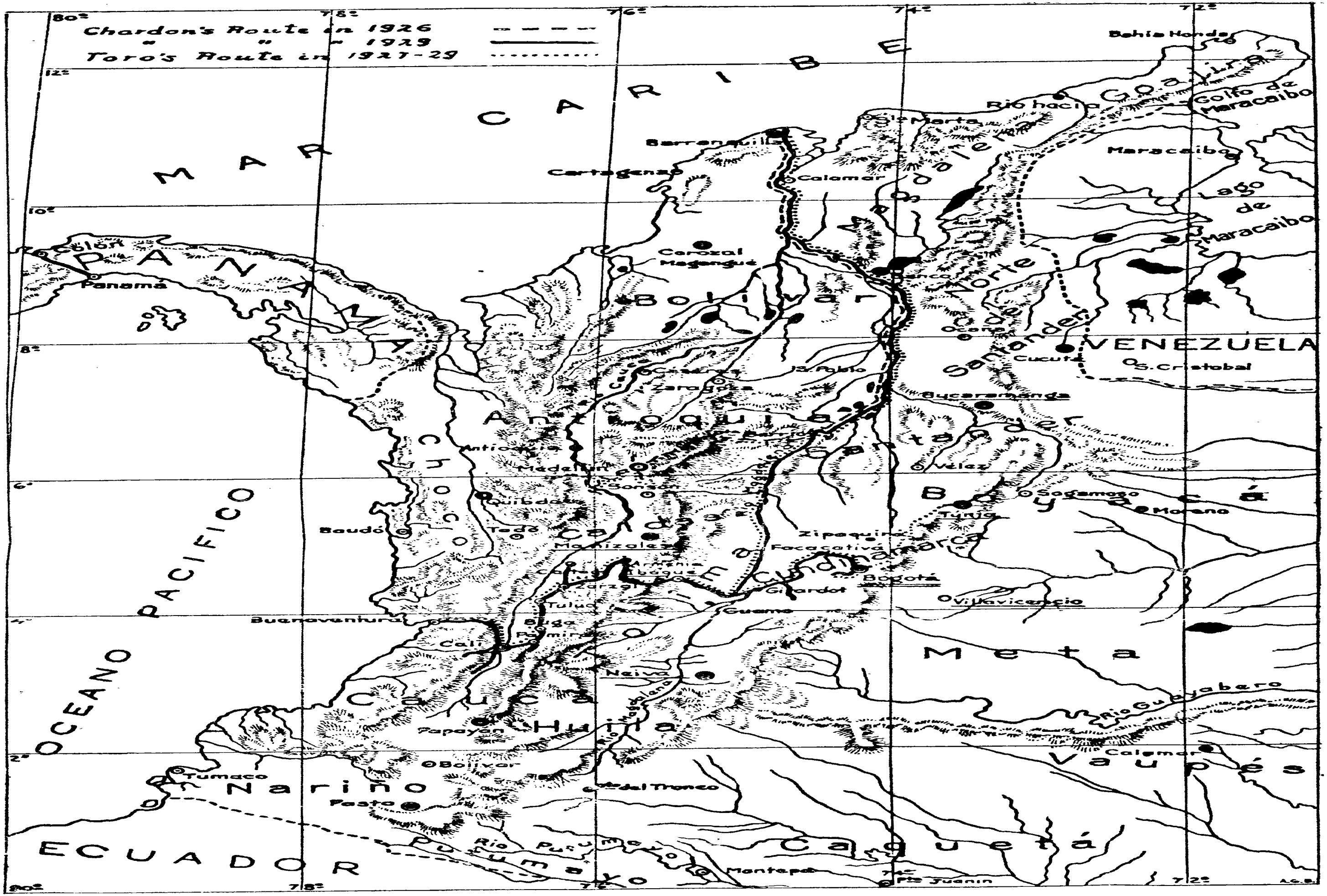

FIG 1.—MAP OF COLOMBIA SHOWING ROUTES OF WRITERS

Cali, where the headquarters were established for a period of two months.

Cali is the commercial center of a large extent of a rich, alluvial plain of over 3,000 sq. miles, about 3,500 feet above sea level, known as the Cauca Valley (for itinerary of this second trip see the map). Many excursions were made through the valley, as far down as Cartago, during which the spare time was used in collecting fungi. The rainfall in this plain ranges from 35 to 47 inches, and the plant growth is rather scant, but along the banks of the Cauca river it is very luxuriant and rich in fungi. Two interesting trips were also made to the region of the Western Andes: one to Bitaco and another to the Colegio de Nuestra Señora de los Andes, reaching nearly 6,000 feet altitude. Here the rainfall averages 87 to 90 inches and the vegetation is luxuriant.

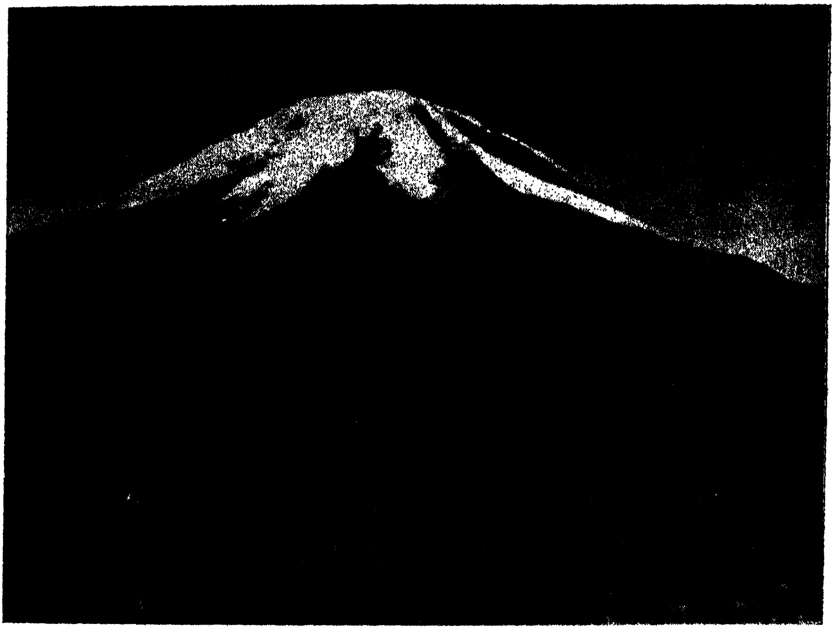

Fig. 2.—Nevado del Tolima, 18720 feet high and covered with perpetual snow is one of the highest peaks of the Central Andes.

On June 18, the senior writer left Cali on a trip to Bogotá, at the invitation of the Minister of Industries, Dr. J. A. Montalvo, to attend an agricultural congress held at the capital. The trip along the Quindio, in the Central Andes, at an altitude of 11,500 feet, was most interesting and afforded opportunity to collect around Armenia and in Ibagué. Bogotá was reached on the 22nd after a spectacular rail trip from Girardot, on the Magdalena.

Bogotá, the capital of Colombia, is located on a plateau, 8,650 feet above sea level in the Eastern Andes. It has a temperate climate with all its characteristic crops: wheat, oats, potatoes, rye, pomaceous fruits, etc. The flora is, naturally, different from all the other regions we had previously visited, and proved to be very interesting from a mycological standpoint. Unfortunately, the senior writer did not have much time to collect up there, and the excursions were limited to a few hikes to Cerro Guadalupe and Monserrate, a visit to the Experimental Farm at La Picota, and a lovely 2-day stay at the Salto de Tequendama. This temperate region of Colombia proved to be of exceptional interest mycologically, and many rare or new forms were found. It is one of the most promising collecting places known to the writers: here, for the first time, collections and observations were made on the cereal smuts and rusts of Colombia, which may be of interest to the northern phytopathologist.

On our way back from Bogotá, two days were spent in Apulo and at the San Antonio sugar mill, in the dry, warm section of Cundinamarca, and we again reached the Cauca valley, through the Quindio Pass. This finished our collecting, since the last three weeks of our stay in Cali were spent in the preparation of our report.* In this second trip, 571 numbers of fungi were collected representing a great variety of species.

ACKNOWLEDGMENTS

The writers wish to express their appreciation to the various mycologists who have actively collaborated in the preparation of this work and contributed portions of the manuscript on the various special groups. Among these are: Dr. W. C. Muenscher, of Cornell University, on the Myxomycetes; Dr. W. H. Weston Jr., of Harvard University, on the Phycomycetes; Dr. Fred J. Seaver, of the New York Botanical Garden, on the Pezizales; Dr. J. H. Miller, of the University of Georgia, on the Xylariaceae; Dr. H. S. Jackson, of the University of Toronto, on the Ustilaginales; Dr. Charles Chupp, of Cornell University, on the Cercosporae; Dr. L. O. Overholts, of the Pennsylvania State College, on the Higher Basidiomycetes; and Dr. Frank D. Kern, of the same institution, and Professor H. H. Whetzel, of Cornell University, for the treatment of the Uredinales. The following specialists also cooperated in the identification of species: Dr. Wm. H. Diehl, of the Bureau of Plant Industry for determinations of *Camillea*; Dr. W. C. Coker, of the University of North Carolina in the Lycoperdales; Dr. Rafael Ciferri, of Moca, Santo Domingo, for contributing one new genus and two new species and Dr. H. Sydow, of Berlin, gave helpful advice in the Dothideales and contributed three new species.

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* See Chardon, C. E. et al. Reconocimiento Agropecuario del Valle del Cauca. 848 págs. San Juan, P. R. 1930.

A number of phanerogamic specialists collaborated in the determination of the host plants of the collections. These were: Professor B. L. Robinson and Mr. J. M. Johnson, of the Gray Herbarium, Harvard University; Dr. N. L. Britton, Dr. H. A. Gleason and Mr. Percy Wilson of the New York Botanical Garden; Dr. L. H. Bailey, of Cornell University; Dr. W. R. Maxon, Dr. S. F. Blake and Dr. J. R. Swallen of the Smithsonian Institution; Dr. E. P. Killip and Dr. A. C. Smith, of the United States National Herbarium; Professor William Trelease, of the University of Illinois and Mr. Kenneth K. Mackenzie of New York City. To all of these

Fig. 3.—Salto de Tequendama, in Cundinamarca in the Eastern Andes with a fall of 435 feet.

the writers wish to express their acknowledgment for their cooperation.

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OUR COLOMBIAN COLLECTIONS

Our complete collection of Colombian fungi, comprising 1,103 numbers, has been deposited at the herbarium of the department of plant pathology, Cornell University, Ithaca, N. Y., for permanent safekeep.

A total of 384 species of fungi of Colombia are reported here, of which 248 were previously unrecorded from Colombia and 47 are species new to science, 3 of which are from Panama. The number of species hitherto known from Colombia is 362, so the total number of fungi is increased to 610. This represents by far a small percentage of the flora and the need for further studies is self evident.

The following is the distribution of the collection with indication as to its collector, which should serve as a guide to interested students:

Nos. *1–172*, collected by Carlos E. Chardon in Antioquia and the Magdalena, during 1926 (the collector's name is usually omitted);
Nos. *173–212*, collected by C. E. Chardon and J. A. B. Nolla in Panamá in 1929 (collectors' names omitted);
Nos. *213–540* and *730–742*, collected by C. E. Chardon and J. A. B. Nolla in the Pacific Coast of Colombia, Western Andes and the Cauca Valley in 1929 (collectors' names omitted);
Nos. *541–729*, collected by C. E. Chardon in the Central Andres, Tolima and in Cundinamarca in 1929 (collector's name omitted). The collections made by R. A. Toro during 1927–29, about 360 in all, bear his name in parenthesis.

All species new to the flora of Colombia are shown by an asterisk (*) preceding its scientific name.

REVIEW OF LITERATURE

In the bibliographical researches conducted by the writers, forty-four papers have been found dealing with the subject of Colombian mycology. A brief review of these papers follows:

1. CALDAS, F. J. DE. MEMORIA SOBRE LA NIVELACIÓN DE LAS PLANTAS QUE SE CULTIVAN EN LA VECINDAD DEL ECUADOR *in* E. POSADA, OBRAS DE CALDAS, BIBL. DE HIST. NAC. **9**: 85–95. 1912 (WRITTEN IN 1803).

   This is the first work known to the writers in which a mention is made of a fungous disease in Colombia. Caldas, the celebrated Colombian naturalist, mentions a destructive disease of wheat, called *polvillo* and states that it is caused by "una planta parásita, semejante al musgo, que multiplicándose prodigiosamente como toda planta microscópica, ataca la caña y la espiga del trigo, le roba los jugos que iban a alimentar el grano, le debilita y le mata".

   He goes into the discussion of the influence of climatic factors in the prevalence of the disease. From the description which is made of the malady we infer that he was referring to the common wheat rust.

2. HOOKER, W. J. *in* KUNTH, C. S. SYNOPSIS PLANTARUM QUAS IN PLAGAM ACQUINOCTIALEM ORBIS NOVI COLLEGERUNT AL. DE HUMBOLDT ET AM. BONPLAND, FUNGI: 7–15. 1822.

   The first contribution to Colombian mycology appears to have been made by the English botanist W. J. Hooker in this early work of Kunth and based on collections made by the celebrated naturalists Alexander von Humboldt and Amato Bonpland. A report is made of 25 species, most of them new, from the province of Cumaná (Venezuela), the kingdom of New Granada, the kingdom of Quito and the Andes of Perú. Out of these species, only 12 were collected in the territory of Colombia proper, as follows:

Sphaeria digitata Pers.=*Xylaria digitata* Fr.
Sph.? depressa Hook.
Agaricus umbilicatus Hook.=*Lentinus crinitus* (L.) Fr.
Daedalea laevis Hook.=*Fomes applanatus* Pers.
Boletus reticulatus Hook.=*Hexagona reticulata* Klotzsch.
B. tenuis Hook.=*Hexagona tenuis* Fr.
B. fibrosus Hook.=*Trametes fibrosa* Fr.
B. pavonius Hook.=*Polyporus pavonius* (Hook.) Fr.
B. purpurascens Hook.=*Polyporus purpurascens* (Hook.)
Hydnum palmatum Hook.
Thelephora badia Hook.=*Stereum cinereo-badium* Fr.
Peziza nigricans Swartz.=*Hirneola nigricans* Fr.

3. LÉVEILLÉ, J. H. CHAMPIGNONS EXOTIQUES (SUITE), ANN. SCI. NAT. III. **3**: 38–64. 1845.

   Dothidea Goudotii is described here on leaves of *Chusquea*, collected by Goudot in the Paramo of Tolima. This species is now regarded as *Roumegueria Goudotii* (Lev.) Sacc.

4. BERKELEY, M. J. FUNGI *in* CLARK, AND J. D. HOOKER "FLORA ANTARTICA" **1**: 169–175. 1847.

   Berkeley in this early work in 1847, describes *Dothidea circumscripta* on *Vaccinium* from the Andes of Colombia. This species is now regarded as *Sphaerodothis circumscriptum* (Berk.) Th. & Syd. but has not hitherto been recollected in Colombia.

5. TULASNE, E. L. R. FUNGI (DE LA NOUVELLE GRENADE). ANN. SCI. NAT. IV. **9**: 49–52. 1858.

   Dothidea tinctoria is described on *Baccharis polyantha* and *B. genistelloides* from various localities in the Andean region. The species is now included under *Dothidella*.

6. LÉVEILLÉ, J. H. *In* TRIANA J. ET J. E. PLANCHON. PRODROMUS FLORAE NOVO-GRANATENSIS. FUNGI (CRYPTOGAMIE): 151–169. 1863–67.

   The second important contribution on Colombian fungi did not appear until many years later, in 1863–67 when J. H. Léveillé contributed the fungi in Triana and Planchon's "Prodromus Florae Novo-Granatensis". Some 63 species are cited here, based on collections made by Alex. Lindig, J. Triana and Just. Goudot. The species new to Hooker's list were as follows:

MYXOMYCETES.

Leocarpus vernicosus Lnk.=*Diderma vernicosum* Pers.
Enerthema muscorum Lev.=*Lamproderma scintillans* Morg.?

DISCOMYCETES.

Peziza Patena Lev.
P. flammea Alb. & Schw.=*Perrotia flammea* (A. & Schw.) Boud.
Hysterium foliicolum Fr.=*Stictis foliicola* B. & C.? both on *Clusia*.
Phacidium Clusiae Lev.=*Coccomyces Clusiae* (Lev.) Sacc.
Ph. Musae Lev.=*Coccomyces Musae* (Lev.) Sacc.
Ph. tridentatum Lev.

PYRENOMYCETES.

Meliola furcata Lev.
Hormosphaeria tesselata Lev.=*Bagnisiella tesselata* (Lev.) Cke.
Sphaeria coccinea Pers.=*Nectria coccinea* Fr.
Sph. sanguinea Pers.=*N. sanguinea* Fr.
Sphaeria sordidula Lev.
Sph. stilbostoma Fr.=*Valsa stilbostoma* Fr.
Sph. melanococca Lev.
Sph. implicata Lev.
Sph. discoidea Lev.=*Nummularia*
Sph. obesa (Fr.)=*Hypoxylon obesum* Fr.
Sph. marginata Schw.=*Hypoxylon marginatum* (Schw.)
Sph. serpens Pers.=*Hypoxylon serpens* Fr.
Chaenocarpus melanurus Lev.
Xylaria cubensis Mont.
X. Trianae Lev.
X. cylindrica Lev.
X. trachelina Lev.
X. monticulosa Lev.
X. metaeformis Lev.

BASIDIOMYCETES.

Marasmius ramealis Bull.
Lenzites myriophylla Lev.
Polyporus Lindigii Lev.
P. hymeninus Lev.=*Poria*
P. versiporus Pers.=*Poria*
P. tenax Lev.=*Poria*
P. chryseus Lev.=*Poria*
Polystictus floridanus Berk.

Polyst. candidus Lev.
Favolus granulosus Lev.
Radulum trachyodon Lev.
Stereum villosum Lev.
St. Goudotianum Lev.
St. (?) *vitellinum* Lev.
Corticium roseum Fr.

UREDINALES.

Trichobasis Oxalidis Lev.—(first rust report—*Puccinia Oxalidis*)

GASTEROMYCETES.

Lycoperdon pyriforme Pers.
Bovista fusca Lev.

IMPERFECTS.

Tubercularia depressa Lev.
Ollulla pezizoidea Lev., *Hendersonia stictica*, Lev.
Rhabdospora Melastomatis Lev.

7. ANDRÉS, M. TOUR DU MONDE. **2**: 358. 1879.

A *Cordyceps* from Colombia is figured here on the larvae of a coleoptera, known under the common name of *Cuso*, which N. Patouillard (Bull. Soc. Mycol. France **11**: 229. 1885) thinks is the same as *Cordyceps cusu* Pat. from Ecuador.

8. COOKE, M. C. EXOTIC FUNGI. GREVILLEA **15**: 18. 1886.

Gleosporium Vanillae is described on *Vanilla planifolia* from Antioquia.

9. KARSTEN, P. A. ET P. HARRIOT. FUNGILLI IMPERFECTI NOVI. JOUR. DE BOTANIQUE **4**: 365. 1890.

Septogleum Clusiae is described on *Clusia* leaves from New Granada based on a collection by Lindig.

10. MASSEE, G. EXOTIC FUNGI. GREVILLEA **22**: 67–68. 1894.

Describes *Phyllosticta Anibae* on decaying fruit of *Aniba perutilis* Hemsl. from Antioquia.

11. HENNINGS, P. BEITRAGE SUR PILZFLORA SUDAMERIKAS–II. HEDWIGIA **36**: 190. 1897.

A few fungi, and two new species, are listed here, collected by Bennings, mostly from around Buenaventura. These are:

Polystictus sanguineus (L.) Meyer.
Polyporus Benningsii sp. nov.
Lentinus crinitus (L.) Fr.
Phyllachora Lehmanniana sp. nov. on *Vochysia Lehmanni* from Dolores, Tolima.

12. DELACROIX, G. QUELQUES ESPECES NOUVELLES. BULL. SOC. MYC. FRANCE **13**: 114–116. 1897.

Clanostachys Theobromae is described on fruits and twigs of *Theobroma Cacao* L. from Colombia.

13. MONTOYA Y FLORES, J. B. RECHERCHES SUR LES CARATÉS DE COLOMBIE. THESE. 146 pp. PARIS. 1898.

The researches presented in this paper are the results of observations and studies made in Antioquia, where the violet *carate* and its numerous varieties are predominant.

The author goes deeply into the origin and nature of these skin affections and concludes that they are dermatomycoses produced by fungi of the *Aspergillus* group which are always present and easily obtainable in the skin scales of the lesions. They were obtained in pure culture.

The botanical characters of the organisms were found as follows:

1. Ash-violet *carate*. Approaches very much the *Penicillium* type of fungi.
2. Violet *carate*. A fungus was found which according to Van Tieghem was intermediate between *Aspergillus* and *Penicillium*.
3. Blue *carate*. An Aspergillus with large fruiting bodies.
4. Violet Black *carate*. A typical *Aspergillus*.
5. Black *carate*. Resembles morphologically certain species of *Microsporon*.
6. White *carate*. Resembles a *Microsporon*.
7. Red *carate*. An *Aspergillus*.

The author did not go into the specific determination of these fungi.

14. EARLE, F. S. SOME FUNGI FROM SOUTH AMERICA. Bull. TORREY BOT. CLUB **26**: 632–634. 1899.

Prof. F. S. Earle was the first American mycologist to take an interest in the study of Colombian fungi. In 1899, he published this short paper based on collections made by C. F. Baker, near Santa Marta. He was assisted in his determinations by A. P. Morgan (in the Xylariaceae) and P. Dietel (in the Uredinales). Sixteen fungi were reported, five of which were new species, as follows:

Coleosporium Elephantopodis (Schw.) Thüm
Puccinia claviformis Thüm.
Puccinia appendiculata Wint.
Puccinia bombacis Dietel sp. nov.
Uromyces manihotis P. Henn

Uromyces cissampelis Dietel sp. nov.
Sorosporium syntherismae (Schw.) Earle.
Hymenochaete purpurea Cke. & Morg.
Auricularia nigra (Schw.) Earle.
Tryblidiella rufula (Spreng.) Sacc.?
Asterina Melastomatis Lev.?
Phyllachora graminis (Pers.) Fckl.
Apiospora sparsa sp. nov.
Hypoxylon coccineum Bull.
Hypoxylon Bakeri sp. nov.
Marsonia agaves sp. nov.

15. DELACROIX, G. SUR DEUX MALADIES DU VANILLIER. BULL. SOC. MYC. FRANCE **18**: 276. 1902.

Gives *Calospora Vanillae* Massee as the perfect stage of *Gloeosporium Vanillae* Cooke, after some inoculation work.

16. HENNINGS, P. EINIGE NEUE PILZE AUS COSTARRICA UND PARAGUAY. HEDWIGIA **43**: 147–149. 1904.

One species, *Dothidella Stübelii* sp. nov. is described here on *Pteris reflexa* from Bogotá collected by A. Stübel. It is interesting to note that the potato rust, *Puccinia Pittieriana* was first described here from material collected in Costa Rica by H. Pittier. This rust was found by us in Colombia and it is being reported by Kern in this paper.

17. FUHRMANN, O. ET EUG. MAYOR. VOYAGE D'EXPLORATION SCIENTIFIQUE EN COLOMBIE. MEM. SOC. NEUCH. SCI. NAT. **5**: 1–1087. 1914.

A very important event in the progress of mycological science in Colombia was the visit of the Swiss naturalists Drs. O. Fuhrmann and Eug. Mayor in 1910, and the publication, a few years later of the results of their collections and researches, with the collaboration of a number of European specialists, covering many groups of plant and animal life. A fine and interesting description of their trip is made in the introduction, which covered the Magdalena River as far as Puerto Berrio, then to Medellin, up to the Cauca, Manizales, Nevado del Ruiz, reaching again the Magdalena basin at Honda, Bogotá, and then return back through Girardot and the river. In this account, some notes are given on the coffee leaf spot (*Stilbella flavida*) and on a root disease.

The gasteromycete, *Geaster saccatus* is reported (p. 58) in a forest, near the Cauca River.

18. MAYOR, EUG. Contribution á l'Étude des Uredinées de Colombie. Mem. Soc. Neuch. Sci. Nat. **5**: 442–599. 1914.

Prof. Eug. Mayor, the botanist of the expedition, and a mycologist himself, collected many fungi, specially rusts. This group was studied critically by Dr. Mayor himself a very ellaborate paper appeared covering 'this group. Previous to Mayor's work, only *6* rusts had been reported from Colombia. The number was increased very materially with this paper, 158 species being reported, 84 of which were described as new to science. Details about this paper will be found in Dr. Kern's treatment of the Uredinales of our collections.

19. SYDOW, H. ET P. Contribution á l'Étude des Champignons parasites de Colombie. Mem. Soc. Neuch. Sc. Nat. **5**:432–441. 1914.

A study is made here of 42 species of parasitic fungi based on collections made by Dr. Eug. Mayor in 1910 in Colombia and the West Indies. A dozen new species are described. The following is the list of 39 species reported from Colombia proper.

BASIDIOMYCETES.

1. *Exobasidium Gaylussaciae* P. Henn.

USTILAGINALES.

2. *Cintractia axicola* (Berk.) Cornu.
3. *Sphacelotheca Hydropiperis* (Schum.) de Bary.
4. *Urocystis Anemonis* (Pers.) Wint.

PHYCOMYCETES.

5. *Peronospora Borreriae* Lagh.
6. *Cystopus candidus* (Pers.) Lev.
7. *C. brasiliensis* Speg.
8. *C. Bliti* (Biv.) de Bary.
9. *C. Portulacae* (DC.) Lev.
10. *C. platensis* Speg.
11. *C. Ipomoeae-panduranae* (Schw.) Stev. & Sw.

ASCOMYCETES.

12. *Meliola Lantanae* sp. nov.
13. *Mycosphaerella Drymariae* sp. nov.
14. *Didymella Penniseti* sp. nov.
15. *Phyllachora peribebuyensis*=*Dothidina peribebuyensis* (Speg.) Chardon
16. *Ph. Ambrosiae* (B. & C.) Sacc.
17. *Ph. Espeletiae* sp. nov.
18. *Ph. perlata* sp. nov.
19. *Ph. Eriochloae* Speg.=*Ph. Eriochloae* var. *columbiensis* Th. & Syd.
20. *Ph. paspalicola* P. Henn.

21. *Ph. Pazschkeana* Syd.
22. *Ph. graminis* (Pers.) Fuck=*Ph. puncta* (Schw) Orton
23. *Dothidea Anthurii* Bomm. & Rouss=*Phyllachora Engleri* Speg.
24. *Montagnella Puiggarii* Speg.=*Phragmocarpella Puiggarii* (Speg.) Th. & Syd.
25. *Niptera aureo-tincta* sp. nov.
26. *Calloria quitensis* Pat.
27. *Melanochlamys leucoptera* sp. nov.

FUNGI IMPERFECTI.

28. *Macrophoma Symbolanthi* sp. nov.
29. *Darluca filum* (Biv.) Sacc.
30. *Septoria Balansae* Speg.
31. *S. inconspicua* B. & C.
32. *S. albo-maculans* Syd.
33. *Oidium erysiphoides* Fr.
34. *O. leucoconium* Desm.
35. *Cercospora Liabii* sp. nov.
36. *Heterosporium paradoxum* sp. nov.
37. *Illosporium Mayorii* sp. nov.
38. *Cerebella Paspali* Cke. & Mass.
39. *Tuberculina persicina* (Ditm.) Sacc.

20. LINDAU, G. DIE AUF KULTIVIERTEN UND WILDEN ORCHIDEEN AUFTRETENDEN PILZE UND IHRE BEKAMPFUNG. GARTENFLORA BEIL ORCHIS **9**: 177. 1915.

The rust *Uredo Scabies* Cooke is reported on *Vanilla planifolia* from Colombia.

21. SYDOW, H. ET. P. NOVAE FUNGORUM SPECIES—XIII. ANN. MYCOL. **13**: 35–43. 1915.

Describes the smut *Entyloma Galinsogae* Syd. on *Galinsoga caracasana* based on a collection made by Eug. Mayor, in Antioqua.

22. THEISSEN, F. BEITRAGE ZUR SYSTEMATIK DER ASCOMYCETEN. ANN. MYCOL. **14**: 404. 1916.

The perisporiaceous species *Epiphyma neurophylum* sp. nov. is described on *Tibouchina*, based on collection made by Mayor, in Medellin.

23. KEISSLER, K. ÜBER PILZE AUF ORCHIDEEN IMM REICHENBACH'SEN HERBAR. BOT. CENTRALB. BEIHT. **36**^{2}: 316. 1918.

Colletotrichum Orchidearum Allesch is reported on *Cattleya* and *Epidendrum macrostachum*, as from Bogotá (Bolivia). Probably an error of country.

24. FITZPATRICK, H. M. MONOGRAPH OF THE CORYNELIACEAE. MYCOLOGIA **12**: 206–267. 1920.

Corynelia oreophila (Speg.) Starbäck is reported on *Podo carpus sp.*—from phanerogamic herb. at Harvard University. "Colombia".

25. SYDOW, P. & H. MONOGRAPHIA UREDINEARUM IV. LEIPZIG. 671 P. 1924.

In a study of Uredinales of the world, the following species from Colombia are excluded and referred to the genus *Woroninella:*

Aecidium amagense Mayor on *Desmodium tortuosum* and *D. cajanifoium.*

Aecidium eriosematis P. Henn. (*A. medellinense Mayor*) on *Eriosema* sp.

26. PEÑA CHAVARRIA, Y P. C. SHIPLEY. CONTRIBUCIÓN AL ESTUDIO DE LOS CARATES DE AMÉRICA TROPICAL. REV. MÉDICA LATINO-AMER. **10**: No. 114, 76 pp. 1925.

This is an excellent symposium on the carates of tropical America, and primarily a medical contribution. Photomicrographs are shown here of the various fungi associated with the different types of carates belonging to *Aspergillus, Trichophyton*, and *Alternaria* but the authors do not go into their specific names.

27. CHARDON, C. E. "LA GOMOSIS" UNA EPIDEMIA GRAVE DE LA CAÑA EN ANTIOQUIA. ESC. AGRIC. Y VET. MEDELLIN, CIRC. NO. 1. 1926.

Bacterium vascularum (Cobb.) E. F. Smith is reported as causing a widespread epiphytotic of sugar-cane gomosis. The identity of the organism was not definitely established on cultural characters, etc., but the leaf symptoms and gum exudation of the stalk was typical.

28. CHARDON, C. E. AND R. A. TORO. PLANT DISEASE NOTES FROM THE CENTRAL ANDES. PHYTOPATH. **17**: 147–153. 1927.

This is a progress report on the plant diseases found by Chardon in the Central Andes of Antioquia in 1926. A number of fungi associated with plant diseases are given, of which the following were additions to the flora:

Rosellinia bunodes B. & Br. (*Dematophora* stage).
Capnodium brasiliense Pat. & Maubl.
Kuehneola Fici.

Melanconium Sacchari Massee
Leptosphaeria Sacchari Br. de Haan.
Sphaceloma Fawcetti Jenkins
Pestalozzia palmarum Cooke.
Septoria Lycopersicci Speg.
Phyllachora gratissima Rehm.

29. GAUMANN, ERNST. MYKOLOGISCHE MITTEILUGEN III. ANN. MYC. **25**: 167–176. 1927.

This paper is a revision of the genus *Woroninella,* to which genus the author refers some species of *Aecidium* described by Mayor from Colombia. *Aecidium medellinense* Mayor is a synonym of *A. eriosematis* P. Henn. and should be known as *W. eriosematis* (P. Henn.) Sydow and *A. amagense* Mayor is recognized as *W. amagense* (Mayor) Sydow.

30. KERN, F. D. AND C. E. CHARDON. NOTES ON SOME RUSTS OF COLOMBIA. MYCOLOGIA **19**: 268–276. 1927.

Thirty three species of rusts collected by Chardon, mostly from Antioquia, are cited here. No new species are recorded, but 10 of them are new to the Mayor list, and four are reported new to South America.

31. TORO, R. A. ENFERMEDADES Y PLAGAS DE PLANTAS. ESC. AGRIC. Y VET. MEDELLIN CIRC. No. 4, 33 pp. 1927.

Reports *Cercospora Henningsii* Allesh. on Manihot, *Sclerotium Rolfsii* Sacc. on tomato, *Gleosporium musarum* Cooke on banana and *Phytophthora infestans* (Mont.) de By. on potatoes.

32. TORO, R. A. UN NUEVO ASCOMICETO COLOMBIANO. BOL. SOC. COLOMBIANA HIST. NAT. **16**: 154–156. 1927.

A new species, *Echidnodes Caicedoiana* on leaves of *Caonopia latifolia* is described from Colombia based on material collected by C. E. Chardon at Barranca Bermeja.

33. CHARDON, C. E. CONTRIBUCIÓN AL ESTUDIO DE LA FLORA MICOLÓGICA DE COLOMBIA. BOL. REAL SOC. ESP. HIST. NAT. **28**: 111-124. 1928.

This paper comprises a critical study of the fungi,—except the rusts—collected by Chardon in Antioquia and in the Magdalena River in 1926. Thirty-two species are reported new to Colombia and 6 new to science, as follows:

MYXOMYCETES.

1. *Stemonitis splendens* Rost.
2. *Lycogala epidendrum* (L.) Fries

Phycomycetes.

3. *Pseudoperonspora cubensis* (B. E. C.) Rost.

Discomycetes.

4. *Ascophanus testaceus* (Moug.) Phill.

Pyrenomycetes.

5. *Irene longipoda* (Gaill.) Toro.
6. *Irene Perseae* (Stevens) Toro.
7. *Lembosia Melastomatum* Mont.
8. *Polystigma nigro-viride* Rehm.
9. *Hypocrea rufa* (Pers.) Fr.
10. *Creonectria ochroleuca* (Schw.) Seaver.
11. *Phyllachora cornispora-necrotica* sp. nov.
12. *Ph. puncta* (Schw.) C. R. Orton
13. *Ph. Ischaemi* Syd.
14. *Ph. microstroma* sp. nov.
15. *Ph. antioquensis* sp. nov.
16. *Ph. Mayorii* sp. nov.
17. *Ph. microspora* sp. nov.
18. *Ph. Maydis* Maubl.
19. *Gnomonia Ospinae* sp. nov.
20. *Hypoxylon cohaerens* (Pers.) Fr.
21. *H. rubiginosum* (Schw.) Sacc.
22. *H. haematitis* Lev. var. *microspora* Th.
23. *Daldinia concentrica* (Bolt.) Ces. de Not.
24. *Poronia oedipus* Mont.
25. *Xylaria polymorpha* (Pers.) Grev. (This is *X. rhizocola* Mont.)

Ustilaginales.

26. *Ustilago Zeae* (Beckm.) Unger.

Uredinales. (In a separate paper by Kern and Chardon)

Basidiomycetes.

27. *Auricularia Auricula—Judae* (Bull.) Schroet.
28. *Daedalea repanda* Pers.
29. *Polyporus pinsitus* Fries.
30. *Trametes hydnoides* (Sw.) Fr.

Fungi imperfecti.

31. *Cercospora portoricensis* Earle
32. *C. rigospora* Atk.

34. TORO, R. A. La pequera de los Naranjos. Bol. Soc. Antioqueña Agric. Medellín. 1928.

Reports *Hypocrella turbinata* (Berk.) Petch abundant on the scale insects on Citrus.

35. CHARDON, C. E. NEW OR INTERESTING TROPICAL AMERICAN DOTHIDEALES—II. JOUR. DEPT. AGRIC. PORTO RICO **13**: 3–15. 1929.

Notes and descriptions are given here of 20 species of Dothideales from tropical America, five of which are from the Antioquian Andes, based on collections made by Toro, as follows:

Bagnisiopis tijucensis Th. & Syd.
Achorella Toroana sp. nov.
Dothidina sphaerospora sp. nov.
Robledia tetraspora gen. et sp. nov.
Sphaerodothis antioquensis sp. nov.

36. SEAVER, F. J. STUDIES IN TROPICAL ASCOMYCETES—VI. MYCOLOGIA **21**: 178–179. 1929.

Seaver describes and figures a beautiful and interesting species, *Phyllachora Pennelli*, on the leaves of an unknown tree, collected in the Sinu river by F. W. Pennell, and in a latter publication referred it to *Phyllachora Simabae Cedronis* Syd.

37. TORO, R. A. NOTAS MICOLÓGICAS COLOMBIANAS. REV. SOC. COL. CIENCIAS NAT. **18**: 42–43. 1929.

Notes are given here on three rusts collected by the writer, one of them *Trichobasis Oxalidis* Lev. which is now referred to *Puccinia Oxalidis* (Lev.) Diet. & Ellis. and *Milesina Danstaedtiae* Diet. which is changed to *Milesia Danstaedtiae* (Diet.) comb. nov.

38. TORO, R. A. NOTA PRELIMINAR SOBRE LAS ENFERMEDADES DEL CACAO EN ZARZAL. REV. NAC. AGRIC. BOGOTÁ **25**: 114–126. 1929.

This paper on cacao diseases reports the *Monilia* disease in the Cauca Valley. Also a *Colletotrichum* and *Diplodia* associated with pod-rot.

39. TORO, R. A. PLANT DISEASE NOTES FROM CENTRAL ANDES. PHYTOPATH. 19: 969–974. 1929.

Nectria tropica (Woll.) Toro (on coffee).
Thielaviopsis paradoxa (Desm.) v. Hohn on Cane.
Alternaria Brassicae (Berk) Sacc. on cauliflower.
Mycosphaerella brassicicola (Duby) Lindau on cabbage.
Cercospora longissima Cug. on lettuce.
Colletotrichum gloeosporioides Penz. on mango.
Heterosporium echinulatum (Berk) Cooke on carnation.
Penicillium digitatum (Pers) Sacc. on oranges.
Cercospora Capsici H. & W. on pepper.
Helminthosporium Ravenelli Curt. on *Sporobolus*.
Asperisporium Caricae (Speg.) Maub. on papaya.

40. TORO, R. A. El Enrollamiento de las hojas de durazno Rev. de Industrias (Bogotá) **5**: 261–263. 1929.

A report is made here of the peach leaf curl a common disease in the Sabana de Bogotá and caused by *Taphrina deformans* (Berk.) Tul.

41. TORO, R. A. Una epifitotia del Café en Cúcuta. Rev. de Industrias (Bogotá) **5**: 304–305. 1929.

A report is made here on the occurrence of a thread blight or koleroga disease of coffee caused by *Corticium koleroga* (Cooke) v. Höhn in the coffee section of Cúcuta.

42. TORO, R. A. El polvillo del trigo. Rev. de Industrias (Bogotá) **6**: 120–121. 1929.

The wheat rust, *Puccinia graminis* Pers. is reported as common on wheat in the Sabana de Bogotá.

43. TORO, R. A. Una nueva enfermedad de la alfalfa. Rev. de Industrias (Bogotá) **6**: 121–122. 1929.

The fungus *Pseudopeziza medicaginis* (Lib.) Sacc. is reported attacking alfalfa in the Sabana de Bogotá.

44. CHARDON, C. E. ET AL. Reconocimiento Agro-Pecuario del Valle del Cauca. 343 pp. San Juan. 1930.

This recent publication embodies the report of the Porto Rican agricultural commission on the agricultural possibilities of the Cauca Valley. Observations are made on the occurrence and prevalence of plant diseases, most of which are to be credited to Mr. J. A. B. Nolla, the pathologist of the expedition. Fourteen species of fungi, new to the Colombian flora are reported, as follows:

Pythium de Baryanum Hesse on tobacco and eggplant.
Phytophthora Nicotianæ Breda de Haan on tobacco.
Colletotrichum Gossypii South (doubtful) on cotton.
Septoria Apii (Br. & Cav.) Rostrup on *Apium*.
Helminthosporium Oryzæ Breda de Haan on rice.
Phomopsis vexans (Sacc. & Syd.) Harter on eggplant.
Diplodia Theobromæ (Pat.) Nowell on cacao.
Macrosporium Porri E. on onion.
Colletotrichum lindemuthianum (S. & M.) Br. & Cav. on bean.
Gloeosporium limetticolum Clausen on lime.
Penicillium italicum Wehner. on oranges.
Alternaria Solani (E. & M.) Jones & Gr. on potatoes.
Colletotrichum nigrum E. & H. on pepper.
Plasmopara viticola (B. & C.) Berl. & Toni on grape.

MYXOMYCETES

W. C. Muenscher *

Comparatively little work has been done on the Myxomycetes or "slime moulds" of South America, and curiously enough, the first report on the species of this group, appear to be from Colombia. Leveille (**14**) in 1863–67, reported (pag. 158) two species: *Leocarpus vernicosus* (*Diderma vernicosum* Pers.), collected at Tequendama, and *Enerthema muscorum* Lev., collected at La Mesa, San Antonio, both collections made by Lindig.

Sturgis (**29**) cited the earlier collections made in South America and reports sixty species from Argentina and Chile collected by Professor Roland Thaxter in 1905–. Lister (**15**) recorded about fifty species from South America of which twenty were found in Chile, eight in Brazil, three in Venezuela, and one in each of the following countries: Argentina, Bolivia, Ecuador, Paraguay and Perú. Gilbert (**11**) has reported fourteen species from British Guiana and Surinam. None, but the two above cited species, seem to have been recorded from Colombia. This would seem to indicate that they have not been collected to any extent in Colombia. In view of the fact that many species of Myxomycetes are rather cosmopolitan in their distribution, intensive field work should reveal a considerable number of species in an area as large and varied as Colombia.

The following brief list of species, based upon a few incidental gatherings made by Chardon and Nolla, is only a beginning towards a catalog of the Myxomycetes of Colombia. More intensive and extensive field work on this group will probably multiply the list several times.

*1. Physarum javanicum Racib., Hedwigia **37**: 53. 1898.

On debris of *Zea mays* L.

El Valle: Todos los Santos, between San Pedro and Buga, No. *411*, June 4, 1929.

Craterium sp.

This small gathering consists of the remains of over mature sporangia. MacBride suggested that it may be a new species near *Craterium cylindricum* Massee, but better material is necessary to make a specific determination certain.

On wood.

Santander: Magdalena River across Puerto Berrío, No. *128*, June 15, 1926.

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* Contribution from the Department of Botany, Cornell University.

2. STEMONITIS SPLENDENS Rost. Sluz. Monog. 195. 1875.
On dead trunk.
SANTANDER: Magdalena River, across Puerto Rico, No. *130*, June 15, 1926 (det. J. T. MacBride).
EL VALLE: Hacienda Riopaila, S. of Zarzal, No. *392*, May 31, 1929.

*3. HERMITRICHIA CLAVATA (Pers.) Rost. Suz. Monog. 264. 1875.
Only a few sporangia were found among *Arcyria denudata* Wetts.
On a decaying log.
EL VALLE: Bamboo forest near San Pedro, N. of Buga, No. *113*, June 4, 1929.

*4. ARCYRIA CINEREA (Bull.) Pers. Syn. Fung. 184. 1801.
On decaying wood.
EL VALLE: College N. S. de los Andes, above Cali, No. *166*, June 9, 1929; Bamboo forest near San Pedro, N. of Buga, No. *112*, June 4, 1929.

*5. ARCYRIA DENUDATA (L.) Macbr. N. Am. sl-moulds 195. 1899.
On decaying logs.
EL VALLE: Hacienda Riopaila, S. of Zarzal, No. *390*, May 31, 1929; Bamboo forest near San Pedro, N. of Buga, No. *113*, June 4, 1929.

6. LYCOGALA EPIDENDRUM (L.) Fr., Syst. Myc. **3**: 80. 1829.
On dead wood.
EL VALLE: Along Cauca River, near Cali, No. *734*, May 21, 1929.

PHYCOMYCETES.

WM. H. WESTON JR.*

The list of Phycomycetes comprised in this series, although not a very extensive one, compares very favorably in number and interest with those of similar collections reported in recent years from Central and South American regions or from islands in the Caribbean,—collections such as those of Steven's (**28**) from Costa Rica and Panamá, Ciferri (**7**) from Santo Domingo, or Seaver and Chardon (**22**) from Porto Rico. Moreover, it adds appreciably to the representatives of this group previously reported from Colombia. Sydow (**31**) in his enumeration of the fungi collected by Mayor lists but seven species, (1 Peronospora and 6 Albugos), while the present collection comprises 16 (Synchytrium 2, Albugo 7, Phytophthora 2,

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* Contribution from the Laboratory of Crytogamic Botany, Harvard University.

Plasmopara, Pythium, and Peronoplasmopara, each 1, and Mucorales, 2). Two of Sydow's are lacking here—*Peronospora Borreriæ,* a rare form scantily known only from Lagerheim's (**19**) original description of conidial material from Ecuador, and from Sydow's record of its occurrence in Colombia, and *Albugo platensis* Speg. which usually is represented in collections from the American tropics, and which Mayor secured in 4 numbers, although only from the Department of Bolívar.

As is wholly natural, the present list comprises chiefly the more obvious parasitic forms which could be gathered in the course of a journey through such a region. Consequently it includes certain species, such as *Albugo candida, A. Bliti, A. Tragopogonis,* and *A. Portulacæ,* among the Albuginaceæ; and *Plasmopara viticola* and *Peronoplasmopara cubensis,* among the Peronosporaceae, which are common and world-wide in their distribution. Yet, on the other hand, it contains *Synchytrium æquatoriensis* hitherto known only from Ecuador from which it was described in 1914 by Sydow (**30**) and from which it had been reported in 1891 by Lagerheim (**19**) as *Synchytrium æcidioides.* Moreover, it includes two species apparently undescribed hitherto, one on *Phaseolus vestitus* Hook, *Synchytrium Phaseoli,* a noteworthy form belonging to the Woroninella—subgenus of Synchytrium,—of which various representatives are widely distributed in the tropics, and the other *Albugo Chardoni,* a most striking and distinctive species on *Cleome anomala,* H. B. K., a host species on which hitherto no Albugo has been reported, even though *Cleome graveolens* and other members of the Capparidaceæ have been reported as hosts for the common species, *Albugo candida,* from which this is sharply differentiated by the distinctive thickening of its conidial wall.

Obviously the region is one of considerable potentialities with respect to interesting Phycomycetes. Our knowledge of this class of fungi in any territory always begins with collections such as this, of orders such as the Peronosporales which occur on crop plants or weeds along the lines of travel and can be secured for study by the simple procedure of making herbarium specimens of their hosts. Such orders as the Ancylistales, Blastocladiales, Monoblepharidales, Leptomitales, and Saprolegniales, which are all primarily aquatic and require a special technique of collecting or trapping and long-continued intensive investigation for adequate description, await study with promise of reward. Also the aerial representatives such as the Mucorales, which rarely strike one's attention in nature and usually must be isolated, cultured, and studied under suitable conditions in the laboratory; the Entomophthorales, which demand considerable knowledge of the habits of their insect hosts for collection and special culture methods for study, and the Endogonales, whose inconspicuous growth and typically subterranean habitat result in their scanty representation in collections even in temperate regions long worked over intensively by mycologists,—all these probably will prove rich fields for investigation in this country in which so promising a start has been made.

ORDER I.—CHYTRIDIALES.

Family 1.—SYNCHYTRIACEÆ.

*7. SYNCHYTRIUM AEQUATORIENSIS (Syd.) Gäumann, Ann. Mycol. **25**: 172. 1927.

Woroninella æquatoriensis Syd., Ann. Mycol. **12**: 486. 1914.

Sydow (**30**) when establishing this species from Ecuador gave the diameter of the sporangia within the sorus as from 20 to 28 u. In this Colombian material this same range in size is encountered, but as extreme measurements give only an inclusive size concept, it may be worth while to add that the sporangia most commonly measure 25 to 30 u by 23 to 27 u (cf. Plate XXX, G). This species, as far as the writer is aware, has been reported hitherto only from Ecuador.

On *Psoralea Mutisii* H. B. K.

CUNDINAMARCA: Ravine between Cerro Monserrate and Guadalupe, above Bogotá, No. *604*, June 25, 1929.

*8. **Synchytrium Phaseoli** Weston sp. nov.

The swollen galls in leaves and stems open like irregular craters in the fashion, similar to the aecia of certain rusts, which characterizes the subgenus Woroninella of Synchytrium. The sporangia are angular, polygonal to polyhedral, with flattened faces of contact when first cleaved out in the sorus (Plate XXX, F.), when free becoming rounded (Plate XXX, E.), swelling slightly, ranging in size from 16–22 u x 14–20 u, most frequently 18–20 x 15–17 u, with a distinctly golden color en masse and content marked with distinct refractive granules, (Plate XXX, E, F.).

This form is very distinct from the preceding in the smaller size of its rounded polygonal sporangia which may range from 16–22 u x 14–20 u, but are usually 18–20 u x 15–17 u. They thus mark this species as distinct from those others in the subgenus *Woroninella* which occur in tropical regions, as most of these have a diameter ranging from 25–30 u. In size they are somewhat nearer to those of *Synchytrium aecidioides* which, usually ranging from 14–16 u in diameter, are the smallest of any in this subgenus.

Gäumann's (**9**) infection experiments, carried out in the East Indies in 1920–21 with related species, demonstrated that certain Synchytria (subgenus Woroninella) are specialized and restricted in host range at least to the genus of host. He concluded that because of this specialization certain scantily described forms for which structural distinctions had not yet been given should be recognized as distinct species on the basis of the genus of host on which they occur. The writer considers Gäumann's work conclusive and regards specialization of parasitism as additional grounds for separating this structurally distinct species on Phaseolus. The host *Phaseolus vestitus* Hook (with *Phaseolus atropurpureus* B. C. from which it is separated with difficulty) grows wild in a range from Salvador through southern Colombia and is a well-defined entity not to be confused with *Amphicarpa*, the host of the closely related *Synchytrium aecidioides*.

The species therefore is described as new and is named for the distinctive genus of host on which it occurs.

Intermingled with sori of *Uromyces appendiculatus*.

On leaves, petioles and stems of *Phaseolus vestitus* Hook.

EL VALLE: Along ravines at Finca Las Cañas, S. of Jamundi. No. *280 b*, May 15, 1929 (type).

ORDER II.—PEROBONOSPORALES.

Family 1—PYTHIACEAE.

9. PYTHIUM DEBARYANUM Hesse.

The report of this fungus is based on studies made by Mr. J. A. B. Nolla, who not only found and determined this common fungus, causing considerable damage ("damping-off") of tobacco seedbeds. but succeeded in obtaining it in pure cultures.

On seedlings of *Nicotiana tabacum* L.

EL VALLE: With no specific number in the collections, but frequently observed in tobacco seedbeds in the Cauca Valley during May, June and July, 1929 by J. A. B. Nolla.

10. PHYTOPHTORA NICOTIANAE Van Breda de Haan., Med. Lands Plant. Batavia **15**: 58. 1896.

This report is also based on Mr. J. A. B. Nolla's studies on the tobacco diseases in the Cauca Valley. It was found attacking seedlings in the seedbeds, causing "damping-off" and leaf spots in the tender leaves. A few diseased tobacco plants sent to Mr. Nolla, from the Department of Cauca, showed the characteristic symptoms of "black shank". Mr. Nolla writes:

"This form of *Phythophthora Nicotianae* from Colombia has been compared critically with that from Porto Rico and differs from the latter only in having slightly smaller sporangia. A few oospores were found in old oatmeal agar cultures."

On seedlings and field plants of *Nicotiana tabacum* L.
EL VALLE: With no specific number, but kept in pure cultures at the Insular Experiment Station by Mr. J. A. B. Nolla.

11. PHYTOPHTHORA INFESTANS (Mont.) DeBary, Jour. Roy. Agr. Soc. England II. **12**: 240. 1876.

Botrytis infestans Mont., Mem. Inst. Fr. **1845**: 313. 1845.

Chardon notes that "The potato blight, which is known under the name of 'gota' causes a great deal of damage, especially in the Sabana de Bogotá, where it seems to be the limiting factor in potato growing. In spite of this heavy loss, no attempt is made to control the disease by spraying with fungicides."

On *Solanum tuberosum* L.
EL VALLE: Gardens at La Cumbre, Cordillera Occidental, No. *518*, June 12, 1929.
CUNDINAMARCA: La Picota Experimental Farm, S. of Bogotá, No. *621*, June 30, 1929.

On *Lycopersicum esculentum* Mill.
EL VALLE: Gardens at La Cumbre, Cordillera Occidental, No. *519*, June 12, 1929.

Family 2.—ALBUGINACEAE.

12. ALBUGO BLITI (Bivon.) Kuntze, Rev. Gen. Pl. **2**: 658. 1891.
Uredo Bliti Biv., Stirp Rar. Sicilia **3**: 11. 1815.
Caeoma Amaranthi Schwein, Trans. Am. Phil. Soc. **114**: 292. 1832
Cystopus Bliti De Bary, Ann. Sci. Nat. IV, **20**: 131. 1863.
Cystopus Amaranthi Berk., Grevillea **3**: 58. 1874.
Cystopus Amaranthacearum Zalew., Bot. Cent. **15**: 223. 1883.
Cystopus Cyathulae Winter Roum., Rev. Myc. **11**: 66. 1889.

This species has been reported previously by Chardon (**4**) on *Amaranthus gracilis* (No. *97* above). Even though oospores are lacking it seems justifiable to refer the specimens on *Iresine* to this species as the conidial stage agrees with that on Amaranthus. Moreover, although *Iresine* is not listed as a host by Wilson (**43**) in his Host Index, it is one of the Amaranthaceae and this species has already been reported by Sydow (**31**) on *Iresine* sp. near Medellín and on the road from Medellín to Bello in Colombia, and by Stevens (**28**) on *Iresine acicularis* from Costa Rica. Examination of Sydow's specimen (No. *153*) in the Farlow Herbarium shows convincing agreement. It is of interest that all of these specimens on Iresine are of the conidial stage only.

On leaves of *Amaranthus gracilis* Desl.

ANTIOQUIA: Fredonia, No. *97*, May 25, 1926.

EL VALLE: Near La Cumbre, Cordillera Occidental, No. *513*, June 12, 1929.

On leaves of *Amaranthus spinosus* L.

EL VALLE: Hacienda El Hatico, between Cerrito and Palmira, No. *349*, May 23, 1929.

On leaves of *Iresine celosia* L.

EL VALLE: Near Toro, No. *534*, June 12, 1929.

13. ALBUGO CANDIDA (Pers.) Kuntze, Rev. Gen. Pl. **2**: 658. 1891.

Aecidium candidum Pers. in Gmelin Syst. Nat. **22**: 1473. 1791.

Uredo candida Pers. Syn. Meth. Fung. 223. 1801.

Uredo Cheiranthi Pers. Syn. Meth. Fung. 224. 1801.

Cystopus candidus Lev. Berk. Jour. Hort. Soc. Lond. **3**: 271. 1848

Previously reported from Cundinamarca by Sydow (**31**) on this host and on *Nasturtium officinale* R. Brown.

On stems and leaves of *Capsella Bursa-pastoris* (L.) Med.

CUNDINAMARCA: Near hotel at Salto de Tequendama, No. *637*, July 6, 1929.

14. ALBUGO IPOMOEAE-PANDURANAE (Schwein.) Swing., Jour. Myc. **7**: 112. 1891.

Aecidium Ipomoeæ-panduranæ Schwein. Schr. Natur. Ges. Leipzig **1**: 69. 1822.

Cystopus Ipomoeæ-panduranæ Stev. & Swing. Trans. Kan. Acad. Sci. **11**: 67. 1889.

Previously reported from Antioquia on *Ipomoea caloneura* Meissner by Sydow (**31**).

Even without any oospores and without precise specific identification of the host, which with this scanty material of leaves only is impossible, the determination of this species seems justifiable. The hosts in both numbers were wild Ipomoeas, hence the fungus could not be *A. minor* which Ciferri (**6**) has found limited to the cultivated sweet potato, neither, as the collections were made in the Cauca

Valley far inland, could it be *A. Ipomoeæ pes-capræ* which he found limited to the goats-foot Ipomoea of the sea shore. Further cross-inoculation experiments to determine the limitation of host range in the Albugos on various Ipomoeas in the tropics is much to be desired.

On leaves of Ipomoea sp. (possibly *I. rubra*).

El Valle: Near Buenaventura No. *211*, May 8, 1929; near Santa Ana, No. *343*, May 23, 1929; Hacienda Riopaila, S. of Zarzal, No *402*, May 23, 1929.

*15. Albugo minor (Speg.) Cif., Nuo. Gior. Bot. Ital. n. s. **35**: 132. 1928.

Cystopus convolvulacearum var. *minor* Speg. Ann. Soc. Ci. Argent. **17**: 128. 1884.

Albugo Ipomoeæ-panduranæ (Schwein) Swing. Jour. Mycol. **7**: 112. 1891. (in part)

In spite of the fact that Schweizer (**21**) has shown that moisture and the nature of the host plant can influence the morphological characters of such a related parasite as *Bremia lactucæ,* and in spite of the fact that further cross-inoculation studies and critical comparisons of Albugos on Ipomoea and other Convolvulaceæ are needed to put the classification on a sound basis, still the differentiation by Ciferri (**6**) of *A. minor* on sweet potato and *A. Ipomoeæ pes-capræ* on *Ipomoea pes-capræ* on the basis of host limitation and of size differences in the oospores seems worthy of acceptance. This specimen, agreeing in conidial characters with the description of Ciferri is therefore referred to his species even though no oospores are present.

On leaves of *Ipomoea batatas* (L.) Lam.

El Valle: Finca "Rincón" along river Pance, south of Cali, No. *255*, May 14, 1929.

16. Albugo Portulacae (D. C.) Kuntze, Rev. Gen. Pl. **2**: 658. 1891.

Uredo Portulacae D. C. Fl. Fr. **6**: 88. 1815.

Previously reported by Sydow (**31**) on this same host from Bolívar. The conidiophores of No. *229* are somewhat more elongate than is customary in material of the species. Otherwise the agreement is very close in the conidial phase, all that is present in both specimens.

On leaves and stems of *Portulaca oleracea* L.

El Valle: Along road from Cali to Palmira, No. *229*, May 11, 1929; Hacienda Riopaila, and south of Zarzal, No. *401*, May 31, 1929.

17. ALBUGO TRAGOPOGONIS (D. C.) S. F. Gray, Nat. Arr. Brit. Pl. **1**: 540. 1821.

Uredo candida var. *Tragopogoni.* Piers. Syn. Meth. Fung. **233.** 1801.

Cystopus brasiliensis Speg. Bol. Acad. Ci. Cordoba **11**: 481. 1889.

Previously reported (as *Cystopus brasiliensis*) by Sydow (**31**) from Antioquia on *Ageratum conyzoides*, six collections, and on *Eupatorium conyzoides* Vahl. one collection.

Wilson (**41**) after examining specimens on *Ageratum conyzoides* from Ecuador and from Brazil concluded that *Cystopus brasiliensis* of Spegazzini is not distinct from *A. tragopogonis*. The writer, after comparing these new collections from Colombia (of which No. *411*) fortunately contains abundant oospores, and material in the Farlow Herbarium of *A. brasiliensis* on *Ageratum conyzoides* and on *Alomia microcarpa* (Benth.) Rob. from Sydow, with specimens of *A. tragopogonis* is convinced that Wilson is correct and hence relegates these numbers to the latter species.

On leaves of *Ageratum conyzoides* L.

EL VALLE: Near College of Nuestra Señora de los Andes above Cali. No. *441*, June 9, 1929.

On leaves of *Jaegeria hirta* Less.

EL VALLE: Near College of Nuestra Señora de los Andes above Cali, No. *451*, June 9, 1929.

On leaves of *Ageratum conyzoides* L.

ANTIOQUIA: Granizales. No. *273* (coll. R. A. Toro), September 11, 1927.

*18. **Albugo Chardoni** Weston sp. nov.

Sori on the leaves prominent, white, conspicuous, abundant rounded or slightly irregular in outline (Plate XXXI, B.), frequently crowded at the base or tips of leaves and following veins in irregular groups (Plate XXXI, A.). Conidiophores when young cylindrical to tapering about 45 x 14 u (Plate XXXI, C, D.), later after continued sporulation, elongate, fusiform or tapering, 60–75 u x 12–14 u (Plate XXXI, F, I.), the thickened basal wall hyaline. Conidia dissimilar, the terminal (Plate XXXI, J.) larger, usually 18–21 x 15–18 u, broader, more rotund, the peculiar wall thickening less pronounced. hyaline, the latter conidia (Plate XXXI, K.) hyaline, narrower, and more elongate, the distal end domed, the sides tapering to narrower usually truncate base, the size smaller ranging from 14–20 x 13–18 u but usually 16–19 x 14–17 u, the wall characteristically thickened across the base and up the sides but thin throughout the domed, distal portion. Oospores not seen. Type in Fungi of Colombia in the Cornell Herbarium and duplicates in the Farlow Herbarium at Harvard.

The writer hesitates to present a species as new on the basis of conidial material solely, but in this case the conidial pecularities seem sufficiently marked to warrant establishing this as distinct. The older conidiophores (Plate XXXI, F, I.) with their elongate and relatively slender shape, are easily separated from most species, being approached only by those of *Albugo Froelichiæ* of Wilson (**41**). When producing their first conidia the conidiophores are shorter, perhaps 45 u (Plate XXXI, C.), and there are indications (Plate XXXI, D, I.) that as sporulation continues they proliferate until very elongate. Clumps of noticeably long conidiophores frequently may be seen in the center of developing pustules.

Moreover, the characteristic thickening of the wall of the conidia is a distinctive feature. This thickening seems to differentiate a third conidial type in Albugo in addition to the two usually emphasized, one with the conidia rotund, approximately spherical, the wall relatively thin and of equal thickness throughout, as in *Albugo candida;* the other type with from usually more cylindric and wall characteristically distinguished by a median angular thickening as in *A. Tragopogonis.* In this third type, the conidia are somewhat cylindric but with the distal end domed, the sides tapering to a narrower truncate base and the wall thick (up to 2.5 u) across this base and up the sides but thin, (usually less than 1 u) throughout the domed summit. As far as the writer can determine, this type of thickening has been reported in but one other species, namely *Albugo tillaeæ* which Lagerheim (**19**) described on *Tillaea rubescens* from the outlying streets of Quito, Ecuador. Lagerheim's description that "La membrane de la partie inférieure des conidies est plus épaisse que celle du sommet," and his figure 3A of Plate 11 were the first to emphasize this feature and leave little doubt that it is the same type as that of this new species on Cleome from Colombia. Yet there is no possibility that the two are identical. The hosts are quite unrelated, *Tillaea rubescens* being a member of the Crassulaceæ and *Cleome anomala* one of the Capparidaceæ, and the conidia on *A. tillaceæ,* although of the same shape and with the same wall thickening of those in *A. Chardoni* are much larger, being from 20 to 24 u long by 20 to 21 u broad.

The host species, a member of the Capparidaceæ, is an addition to the list of hosts for species of the genus Albugo. The only other Albugo recorded on members of this genus is *Albugo candida,* which in the past has been reported on *Capparis rupestris, C. spinosa,* and on *Cleome graveolens* in the family of the Capparidaceæ. The present species, however, is quite unlike *Albugo candida* in the extreme length and slender, tapering form of its older conidiophores, and in the characteristic shape and distinctive wall thickening of its conidia. It is much to be regretted that no oöspore material is available, but the species in its conidial phase seems none the less to be a particularly distinctive one.

This species, therefore, is tentatively described as new and is named after Carlos E. Chardon, who not only collected it but also appreciated its distinctive characters and tentatively suggested that it might prove to be a new species.

On leaves of *Cleome anomala* H. B. K.

CUNDINAMARCA: In wet meadows above the Salto de Tequendama, No. *668*, July 6, 1929 (type).

Family 3.—PERONOSPORACEAE.

19. PLASMOPARA VITICOLA (B. & C.) Ber. & DeT., Syll. Fung. **7**: 239. 1888.

Botrytis viticola Berk. & Curt., Jour Hort. Soc. London **6**: 289. 1851.

Peronospora viticola DeBary., Ann. Sci. Nat. IV **20**: 124. 1863.

Rhysotheca viticola G. W. Wilson., Bull. Torrey Bot. Club **34**: 407. 1907.

This most frequent parasite of the grape, causing the well-known grape mildew and co-extensive with its host throughout the world, is apparently common, although not devastatingly destructive in this region.

On leaves of *Vitis vinifera* L.

EL VALLE: Finca Piedra Grande, south of Cali, No. *240*, May 14, 1929; near Palmira, No. *533*, June 8, 1929.

CUNDINAMARCA: In manager's garden, Hacienda San Antonio, No. *694*, July 11–12, 1929.

20. PERONOPLASMOPARA CUBENSIS (Berl.) Clint. Conn. Agr. Exp. Sta. Rep. **28**: 335. 1905.

Peronospora cubensis Berk. & Curt. Jour. Linn. Soc. **10**: 363. 1818.

Plasmopara cubensis Humphrey, Rep. Mass. State Agr. Exp. Sta. **8**: 212. 1891.

Pseudoperonospora Cubensis (B. & C.) Rostow. Ann. Inst. Agron. Moscow **9**: 47. 1903. Flora **92**: 422. 1903.

Previously reported from Colombia by Chardon (**4**); of almost world-wide distribution on various members of the Cucurbitaceae.

On leaves of *Cucurbita Pepo.* L.

EL VALLE: Finca Piedra Grande, S. of Cali. No. *248*, May 14, 1929.

ORDER IV.—**MUCORALES.**

Family 1—MUCORACEAE.

*21. CIRCINELLA SPINOSA van Tiegh. & Monn., Ann. Sci. Nat. V. **17**: 305. 1873.

Found associated with lesions on *Theobroma Cacao* produced by the ***Monilia,*** probably secondary. Determined and cultivated by Miss Marjorie Swift, of the N. Y. Botanical Garden.

On *Theobroma Cacao* L.

TOLIMA: From Espinal, sent by Vittorio Sacco to R. A. Toro, on March, 1930. (Culture *50*, by M. Swift, N. Y. Bot. Garden.)

Family 2—CHOANOPHORACEAE.

*22. CUNNINGHAMELLA ELEGANS Londer, Beitr. Krypt. Schw. **3**: 159. 1908.

Found in same condition and association as above.

On *Theobroma Cacao* L.

TOLIMA: From Espinal, sent by Vittorio Sacco to R. A. Toro, on March, 1930. (Culture *51*, by M. Swift, N. Y. Bot. Garden.)

ASCOMYCETES

ORDER I.—**EXOASCALES.**

Family 1—EXOASCACEAE

23. TAPHRINA DEFORMANS (Berk.) Tul., Ann. Sci. Nat: 128. 1866.

Exoascus deformans (Berk.) Fckl.

On *Prunus persica* S. & Z.

This fungus was first reported from Colombia by Toro (**39**) and it is one of the serious troubles attacking peaches in this region.

CUNDINAMARCA: La Picota Experimental Farm, S. of Bogotá. No. *633*, June 30, 1929.

ORDER II.—**PEZIZALES.**

FRED J. SEAVER *

*24. ASCOBOLUS MAGNIFICUS Dodge, Mycologia **4**: 218. 1912.

This is the first report of this species from continental South America. It is one of the few common discomycetes in Porto Rico.

On cow dung.

EL VALLE: Finca Las Cañas, near railroad track, S. of Jamundi, No. *266*, May 15, 1929; near San Pedro, No. *407*, June 4, 1929.

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* Contribution from the New York Botanical Garden.

*25. ASCOPHANUS CARNEUS (Pers.) Boud., Ann. Sci. Nat. V. **10**: 250. 1869.

On dung.

EL VALLE: Vicinity of Cali, No. *729*, May 18, 1929.

*26. PATELLA CUBENSIS (B. &.C) Seaver, N. Amer. Cup-Fungi, 160. 1928.

On coffee pulp and dead wood.

ANTIOQUIA: Medellín, No. *174* (coll. R. A. Toro), July 24, 1927.
EL VALLE: In bamboo forest near San Pedro, N. of Buga, No. *414*, June 4, 1929.

*27. ORBILIA LOCISIMIARUM P. Henn. Hedwigia **41**: 19. 1902.

On leaf sheaths of *Guadua latifolia* Kunth.

CALDAS: Along Quindio River, near Armenia, No. *720*, July 14, 1929.

*28. **Belonopsis Ingae** Seaver sp. nov.

Apothecia sessile, gregarious and often confluent, pale yellow and semitranslucent reaching a diameter of .5 mm.; asci clavate, short, 48–20 x 4–5 u; spores slender, straight or slightly curved, 8–10 u; paraphyses very slender with globose apices about 3 u in diameter.

On dead pod of *Inga* sp.

EL VALLE: Hacienda Bitaco, Cordillera Occidental, No. *506*, June 11, 1929 (type).

*29. ERINELLA SIMILIS Bres., Hedwigia **35**: 296. 1896.

On dead wood.

EL VALLE: Hacienda Bitaco, Cordillera Occidental, No. *505*, June 11, 1929.

*30. ERINELLA LONGISPORA (Karst.) Saac. Syll. Fung. **8**: 507. 1889.

Lachnum longisporum Karst. Hedwigia **28**: 191. 1889.

On dead log.

ANTIOQUIA: Tranvía de Oriente, No. *56*, May 18, 1926.

31. CALLORIA QUITENSIS Pat., Bull. Soc. Myc. Fr. **8**: 126. 1892.

On *Relbunium hypocarpium* (L.) Hemsley.

A beautiful species previously collected by Mayor and reported by Sydow (**31**) and common in the middle Andean region.

ANTIOQUIA: Loreto, Nos. *173* and *230* (coll. R. A. Toro), May

10 and 21, 1927, respectively; Medellín, No. *310* (R. A. Toro), Jan. 20, 1928.
EL VALLE: Hacienda Bitaco, Cordillera Occidental, No. *499*, June 11, 1929.

ORDER III.—PHACIDIALES.

32. TRYBLIDIUM RUFULUM (Spreng.) Ellis & Ev., N. Am. Pyrenom. 690. 1892.

On dead wood.

EL VALLE: Exp. Sta. at Palmira, No. *742* (Coll. L. A. Serrano) no date.

ORDER IV.—HEMISPHAERIALES.

(Rafael A. Toro.)

This order was established by Theissen (**35**) to include those fungi with inverse radiate perithecia, which were formerly scattered among other orders of the Pyrenomycetes. Since the establishment of the order, much discussion has taken place as to its systematic position. In the latest monograph of the order by Theissen & Sydow (**37**), a step was made by the inclusion of the family Polystomellaceae, thus establishing a connection with the Dothideales. Spegazzini (**24**), although accepting the limitations of the order, expressed his doubts as to the constancy of the characters involved. Arnaud (**1**) makes a thorough study of some of the members of this order and presents a more fundamental classification based on the morphological characters of the fruiting bodies. He recognizes two orders within the group: the Microthyriales which is constituted by the majority of the elements included by Theissen & Sydow and which have an asterinoid, parasitic mode of life, while in the Hemisphaeriales are included the remaining genera which are probably at most saprophytic. Arnaud's classification lacks in ease of application, while that of Theissen and Sydow, based, as it is, wholly on spore septation and color, is of necessity too artificial.

According to the various authors who have worked with the order, the Hemisphaeriales are related to the Dothideales on the one hand and to the Perisporiales on the other. Gäumann (**10**) points out that the order is intermediate between the Pyrenomycetes and the Discomycetes, near the Phacidiales.

Since our present knowledge of the affinities and relationships of the order are still not clearly defined, we are considering the group as a separate one, adopting the classification of Theissen and Sydow.

Family 1.—STIGMATACEAE.

Coscinopeltella Chardon gen. nov.

Stromata subcuticular, black, radiate (?) crustaceous, convex, with the epidermis intact and clearly visible; locules round, simple or compound through coalescence; asci 8-spored, clavate; spores 1-celled, hyaline; paraphyses absent.

The fungus falls in the tribe Munkiellae, of the Stigmataceae according to the treatment of Theissen and Sydow (l. c.). The general macroscopic characters of the fungus, together with the shape of the asci are highly suggestive of the Stigmataceae, especially the genus *Coscinopeltis* Speg. The excellent illustration published by Spegazzini (**24**, Fig. 22) of the type species of the genus, *C. argentinensis* indicates a very close morphological similarity with our Colombian species.

Spegazzini's diagnosis of the genus is:

"Stromata orbicularia dimidiato-scutiformia, superne laxe punctulata, inferne reticulato-loculigera; asci octospori; sporae 1-loculares, breves hyalinae."

No mention is made in the generic diagnosis of the presence or absence of paraphyses, although its type species, *C. argentinensis* shows them clearly. Theissen and Sydow's (**36**) diagnosis of the genus, however, amends the original diagnosis by adding "asci paraphysati." Since our Colombian species has no paraphyses, a new genus, *Coscinopeltella*, is needed to take care of the species of *Coscinopeltis*, lacking paraphyses.

Type species: *Coscinopeltella Montalvoae* sp. nov.

*33. **Coscinopeltella Montalvoae** Chardon sp. nov.

Spots epiphyllous, round, 1.5–3 mm.in diameter, black, very conspicuous, made up of a larger number (10–50) of minute, black, shiny stromata, 300–100 u in diameter, convex and ostiolate; stromata black, radiate (?), distinctly situated between the cuticle and the epidermis; locule single, lenticular, covered on the roof by the black stroma, seated on a hypostroms at the base, 300–400 u in diameter; asci 8-spored, with the spores inordinate or else biseriate, broad-clavate, with the ascus well thickened to 3–7 u at the end; spores long ellipsoidal, with the upper end obtuse, the lower acute, 1-celled, hyaline, with granular contents, 18–20 x 8–9 u; paraphyses absent.

Named in honor of Dr. José A. Montalvo, former Minister of Industries in testimony of our appreciation for his many courtesies during our visit to Bogotá.

On *Miconia squamulosa* (Sw.) Triana.

CUNDINAMARCA: Ravine between Cerro Monserrate and Guadalupe; above Bogotá. No. *594*, June 25, 1929 (type).

Family 2.—POLYSTOMELLACEAE.

Placoasterina Toro gen. nov.

Mycelium present, hypophodiate, stroma dothideaceous, superficial, centrally fastened to the hypostroma, loculi oval, single or few in each perithecia; asci 8-spored; spores 2-celed, brown; paraphyses filiform.

The genus *Placoasterina* differs from *Armatella* Th. & Syd. by having perithecia with more than one locule and brown spores; from *Placoasterella* Sacc. by having hyphopodiate mycelium; from *Asterina* Lev. in that typical inverse-radiate thyriothecia are absent and from *Prilleuxina* by having a definite hypostroma with distinct loculi. The genus belongs to the Polystomlaleae of the classification of Theissen and Sydow (l. c.) between *Armatella* Th. & Syd. and *Placoasterella* Sacc.

Type species: *Plascoasterina antioquensis* sp. nov.

*34. **Placoasterina antioquensis** Toro sp. nov.

Spots sometimes discolored; epiphyllous, borderingthe stromata with a reddish band about 1 mm. wide; stromata circular, black at the tip, radiate at the base, superficial, 1–2 mm. in diameter; hypostroma epidermal; perithecia with one or few definite, roundish loculi, 125–155 u in diameter, covered with a layer 20–30 u thick, astomous or longitudinally cracked; mycellium hypopodiate, brown, superficial, thick-walled, nearly straight, sparsely branched, septate, 6–8 u wide; hyphopodia mostly unilateral, alternate, few, 1-celled, roundish, 8–12 u in diameter; asci elliptic, sometimes hemispherical, sessile 8-spored, 53–56 x 30–34 u; spores inordinate, ellipsoid, hyaline at first, light brown with age, 2-celled, thick-walled, 23–30 x 10–13 u; cells subequal, sometimes separating; paraphyses filiform, hyaline. (Plate XXXII, C, D).

On leaves of *Miconia desmantha* Benth.

ANTIOQUIA: Near Itagüí; No. *23*, April 29, 1926 (type).

Family 3.—MICROTHYRIACEAE.

*35. ASTERINA BELLUCIAE P. Henn., Hedwigia **43**: 374. 1904.

Asterina Racemosae Ryan, Mycologia **16**: 182. 1924.

Asterina miconicola Ryan, l. c.

A comparison of the Colombian and Porto Rican materials shows a very close similarity with the description of the species. Measurements of a great number of thyriothecia and spores of specimens of the species involved make it impossible to separate them on the basis of measurements of these structures. The Porto Rican material has larger spores than those given by Ryan. They average 20–28 x 10–12 u. (Plate XXXIII, D).

On *Miconia aeruginosa* Naud.

ANTIOQUIA: Armenia, No. *214* (coll. R. A. Toro), April 18, 1927.

*36. ASTERINA DIPLOPODA Sydow, Ann. Myc. **25**: 56. 1927.

The species was previously known from Costa Rica and Venezuela. The fungus on the Colombian material is so abundant in the upper surface of the leaves and petioles that it completely covers the green or yellowish color of these structures.

On *Solanum* sp.

CUNDINAMARCA: Along road beyond Salto de Tequendama, No. *678*, July 7, 1929.

37. ASTERINA HYPOPHYLLA (Schw.) Berk., Theisse Ann. Myc. **10**: 165. 1912.

Dothidea hypophylla Schw. in herb.

This species was reported as *A. Melastomatis* Lev. by Earle (**8**).

On a Melastomaceae.

MAGDALENA: Near Santa Marta, C. F. Baker No. *90*, Nov. 19, 1898.

*38. ASTERINA MEGALOSPORA B. & C., Jour. Linn. Soc. Bot. **10**: 363. 1898.

Asterina confertissima Speg., Bol. Acad. Nac. Cienc. Córdoba **28**: 572. 1919.

Asterina passifloricola Ryan, Mycologia **16**: 183. 1924.

Asterina Tacsoniae Pat. var. *Passiflorae* Ryan, l. c.

On *Passiflora mollissima* (H.B.K.) Bailey.

CUNDINAMARCA: Slopes of Salto de Tequendama, No. *653*. July 6, 1929.

*39. ASTERINA MELASTOMATACEAE (P. Henn.) Th., Ann. Myc. **10**: 165. 1912. (Plate XXXII, B).

Seynesia Melastomataceae P. Henn. Hedwigia **41**: 300. 1902.

On *Miconia* sp.

ANTIOQUIA: Angelópolis, No. *222* (coll. R. A. Toro), July 27, 1927.

*40. ASTERINA MELASTOMATIS (Lev.) Mont. in herb.

Asterina Melastomatis Lev. Ann. Sci. Nat. **33**: 59. 1845.

This species was set as the type of the genus, but the original material on which the description was based has been lost. In view of this fact Theissen (en San Juan) selected as the type a collection from Montagne's herbarium (Crypt. Guayn. No. *580*) collected by Leprieur, and accepted Montagne's concept of the species, making a re-description of it. Since from Leveille's description it is not possible to determine the exact limitations of the species, we deem more acceptable the amended description of Theissen based on Montagne's material.

On *Miconia* sp.

ANTIOQUIA: Vicinity of Medellín, No. *321* (coll. R. A. Toro), Nov. 8, 1927.

*41. ASTERINA MICONIAE Theissen, Ann. Myc. **11**: 440. 1913.

Not *A. Miconiae* Ryan, Mycologia **16**: 181. 1924.

On *Clidemia hirta* (L) D. Don.

ANTIOQUIA: Angelópolis, No. *223* (coll. R. A. Toro) July 27, 1927.

*42. ASTERINA TERTIA Rac., Theiss. in Abh. K. K. Zool-Bot. Ges. in Wien **73**: 103. 1913.

The original material was collected in Java. The Colombian specimens differ in the scattered nature of the colonies, but otherwise they agree with the description.

On *Ruellia* sp.

ANTIOQUIA: Angelópolis, No. *208* (coll. R. A. Toro), July 31, 1927.

*43. ASTERINA VAGANS Speg., Anal. Soc. Cient. Argent. **26**: 48. 1888.

On *Cordia ferruginea* R. & S.

ANTIOQUIA: Santiago, No. *287* (coll. R. A. Toro), Nov. 10, 1927.

*44. **Asterina Uribei** Toro sp. nov.

Spots epiphyllous, round, 4–8 mm. in diameter, dark colored: mycelium radiating; frequently undulate, branches alternate or unilateral, fuscous, septate, cells 40–60 x 6 u; hyphopodia scattered, alternate or unilateral, sessile, somewhat rounded,entire, 5–6 u high, 7–8 u long; thyriothecia scattered, never confluent, flattened-hemispherical, 160–200 u in diameter, composed of radiating hyphae about 3.5 u thick, fimbriate, center pseudo-ostiolate, dehiscence by two or three irregular slits; asci broadly elliptical, thick walled, sessile, 65–68 x 24–27 u; 8–spored; spores conglobate, 1 septate, smooth, hyaline when young, light brown with age, slightly constricted at septum, 24–27 x 10–13 u, each cell sub-spherical, upper cell broader (Plate XXXIII, B).

Differs from other species described on the Melastomataceae by its characteristic peculiarity of giving a reddish coloration to the host tissue underneath the mycelium.

Named in honor of Dr. César Uribe, Colombian parasitologist and scientist.

On *Miconia Toroi* Gleason.

ANTIOQUIA: Angelópolis, No. *225* (coll. R. A. Toro), July 27, 1927 (type).

The number of species of *Asterina* on members of the Melastomaceae is now over 25. Most of these present so many characters in common that a thorough revision of the group is necessary in order to clearly define their characters. So far none of the authors have made mention of species which cause discolorations of the host tissue.

KEY TO KNOWN SPECIES OF ASTERINA ON MELASTOMACEAE IN COLOMBIA:

I. Thyriothecia with a disk of straight, mostly free, toothed hyphae.	
A—Hyphopodia lobed.	
a. Small, 6–8 u long.	*A. Melastomatis*
b. Large, 12–18 u long.	*A. hypophylla.*
II. Thyriothecia without disk.	
A—Hyphopodia globose or cylindrical, lobed.	
a. Thyriothecia less than 170 u in diameter	*A. Belluciae*
b. Thyriothecia over 170 u in diameter	*A. Uribei*
B—Hyphopodia not lobed, slightly wavy.	
a. Hyphopodia 7–10 x 4 u	*A. Melastomatacea*
b. Hyphopodia 6–7 x 5 u	*A. Miconiae*

*45. **Asterinella antioquensis** Toro sp. nov.

Colonies epiphyllous, roundish, numerous, frequently anastomosing to form large, black patches; center of subiculum forming a necrotic lesion on the host tissue, light colored, somewhat raised; thyriothecia black, thickly scattered on the subiculum, non ostiolate, radiate, dehiscence by disintegration of its cells, 150–200 u in diameter; mycelium brown, wavy, thick-walled, anastomosing; 8 u thick, hyphopodia none; asci broadly ovate, thick-walled, sessile, the tip tunicated, the base rounded, 47–52 x 27–31 u; sp. p. ovate, 31–40 u long; spores inordinate, unequally two-septate, slightly constricted, 17–21 x 7–10 u, hyaline at first, fuscous at maturity, lower cell spherical, broader, upper cell ellipsoidal; paraphyses none. (Plate XXXIII, C).

Differs from *A. melastomacearum* Ryan in having larger thyriothecia and smaller asci and spores.

On *Miconia ciliata* (L. C. Rich) DC.

ANTIOQUIA: Angelópolis, No. *246* (coll. R. A. Toro), July 27, 1927 (type).

*46. CALOTHYRIOLUM APIAPHYNUM Speg., Bol. Acad. Nac. Ci. Córdoba **23**: 141. 1919.

On *Persea Persea* (L) Cockerell.

EL VALLE: Andalucía, No. *529*, June 7, 1929.
CALDAS: Armenia, No. *724*, July 14, 1929.

*47. CALOTHYRIUM JODASCUM Speg., Bol. Acad. Nac. Ci. Córdoba **23**: 139. 1919.

On *Aniba perutilis* Hemsl.

ANTIOQUIA: Medellín, Phan. Herb. N. Y. Bot. Garden, collected by Gordon, *No Number*, Nov. 1893.

*48. **Peltella insignis** Toro sp. nov.

Spots amphigenous, light colored, somewhat raised, mostly elliptical, 20–40 x 10–15 mm.; thyriothecia amphigena, mostly epiphylla, closely aggregate, brittle, confluent, occurring on the indentations of the leaf veins, black, dimidate, ostiolate, composed of radiating cells 3 u thick, 80–100 u high, 100–120 u diameter; ostiolum round, distinct, 8–10 u in diameter; superficial mycelium none; asci oblong; thick-walled, sessile, 8-spored, 52–59 x 13–15 u; spores biseriate, one-celled, hyaline, obovate, 10–12 x 5–6 u; paraphyses none. (Plate XXXII, A).

On *Bromelia Pinguin* L.

ANTIOQUIA: Angelópolis, No. *185* (coll. R. A. Toro), July 27, 1927 (tpye).

ORDER V.—PERISPORIALES.

(RAFAEL A. TORO)

This order is considered in the sense of Theissen & Sydow (**37**), except that the genus *Meliola* and its recently established allied genera *Irene* and *Irenina* are separated as a class, the *Meliolineae*. The researches of Arnaud (**1**) have shown that the characters of the perithecia in the Meliolineae tends toward the dothideaceous type and therefore do not correspond to the "fascicle bundle of asci" typical of the Perisporiales.

Family 1.—ERYSIPHACEAE

*49. ERYSIPHE POLYGONI DC. Fl. Fr. **2**: 273. 1805.

On *Cassia occidentalis* L.

EL VALLE: Garden at San Fernando, near Cali, No. *304*, May 18, 1929, (conidial stage).

50. SPHAEROTHECA PANNOSA (Wallr.) Lev. Ann. Sci. Nat. **15**: 138. 1851.

Causing a common mildew on the roses but found only in its imperfect stage. Previously reported by Sydow (**31**) based on collections made by Mayor, as *Oidium leucoconium* Desm.

On *Rosa* sp. (cult.)

EL VALLE: Garden at La Cumbre, Cordillera Occidental No. *516*, June 12, 1929; Garden at Artillery Barracks, Buga, No. *525*, June 5, 1929; (det. C. Wescott).

CUNDINAMARCA: La Picota Exp. Farm, S. of Bogotá, No. *620*, June 30, 1929. (det. C. Wescott).

Family 2.—PERISPORIACEAE

*51. DIMERIELLA CORDIAE (P. Henn.) Theiss., Beih. Bot. Cent **29**²: 67. 1912.

Dimerosporium Cordiae P. Henn. Hedwigia **48**: 4. 1908.

Dimerium Stevensii Garman, Mycologia **7**: 337. 1915.

On *Cordia lanceolata* (Desv.) H. B. K.

EL VALLE: Thickets near San Pedro, N. of Buga, No. *426*, June 4, 1929.

On *Cordia ferruginea* (Lam.) R. & S.

EL VALLE: Finca Las Cañas, South of Jamundi, No. *265*, May 15, 1929.

On *Cordia corymbosa* (L.) Don

EL VALLE: Thickets near San Pedro, North of Buga, No. *425*, June 4, 1929.

*52. DIMERINA EUTRICHA (Sacc. & Berl.) Theiss., Beih. Bot. Cent. **29**²: 65. 1912.

Dimerosporium eutrichum Sacc. & Berl., Rev. Myc. **7**: 156. 1885.

On *Irenina vilis* (Syd.) Stev. on *Valerianodes* sp.

ANTIOQUIA: Salgar No. *367* (R. A. Toro), April 15, 1927.

*53. **Phaeostigme Isazanum** Toro sp. nov.

Spots none; mycelium olivaceous, septate, branching at right angles to main hyphae, cells subequal, sometimes toruloid, 8–12 x 3 u; perithecia round, scattered, superficial, black, 80–100 u in diameter, dehiscence by disintegration of the cellular elements, sometimes ostiolate; asci fasciculate, sessile, ellipsoid, 22–27 x 8–10 u, 8-spored; spores biseriate, 2-celled, brown, not constricted at septum, 7–8 x 2–3 u; paraphyses filiform, hyaline. (Plate XXXII, E).

Named in honor of Dr. José M. Isaza, Director of the Agricultural Experiment Station of Medellín, Antioquia.

Parasitic on mycelium of *Asterinella antioquensis* Toro on *Miconia ciliata* (L. C. Rich.) DC.

ANTIOQUIA: Angelópolis, No. *246* (R. A. Toro), July 27, 1927 Type.

SECTION MELIOLINEAE

KEY TO GENERA REPRESENTED IN COLOMBIA:

Mycelium devoid of setae	
Perithecium with larviform appendages	*Irene*
Perithecium without larviform appendages.	*Irenina*
Mycelium with setae	*Meliola*

*54. IRENE CALOSTROMA (Desm.) v. Hohnel, Ann. Mycol. **61**: 213. 1928.

Sphaeria calostroma Desm., Bull. Soc. Bot. France **4**: 1011. 1857.
Chaetosphaeria calostroma (Desm.) Sacc., Syll. Fung. **2**: 95. 1883.
Meliola Puiggarii Speg., Bol. Acad. Nac. Ci. Córdoba **11**: 492. 1889.
Meliola manca Ellis & Mart., Am. Nat. **17**: 1284. 1883.
Meliola sanguinea Ellis & Everh., Journ. Myc. **2**: 42. 1886.
Meliola rubicola P. Henn., Hedwigia **43**: 140. 1904.
Meliola autummalis Sydow, Ann. Mycol. **2**: 169. 1904.
Meliola calostroma v. Hohnel, Ann. Mycol. **15**: 363. 1917.
Irene manca (E. & M.) Theiss. & Syd., Ann. Myc. **15**: 461. 1917.
Irene Puiggarii (Speg.) Doidge, Trans. Roy. Soc. South Africa **9**: 122. 1919.
Appendiculella calostroma (Desm.) Hohn., Sitz. K. Akad. Wiss. in Wein **128**: 556. 1919.

On *Rubus urticaefolius* Poir.

ANTIOQUIA: Angelópolis, No. *220* (R. A. Toro), July 27, 1927.

On *Rubus* sp.

CALDAS: Ravines near Armenia, No. *522*, June 19, 1929.

*55. IRENE SORORCULA (Speg.) Stev., Ann. Mycol. **25**: 423. 1927.

Meliola sororcula Speg., Bol. Acad. Nac. Ci. Córdoba **11**: 493. 1889.
Meliola compositarum Earle, Bull. N. Y. Bot. Garden **3**: 306. 1905.
Appendiculella compositarum (Earle) Toro, Mycol. **17**: 144. 1925.
Appendiculella compositarum portorricensis (Stev.) Seaver & Toro, Sci. Surv. Porto Rico **8**: 28. 1926.

Irene sororcula (Speg.) var. *portorricensis* (Stev.) Stev., Ann. Myc. **25**: 425. 1927.

The appendages in our specimen are few in number, usually 4–6, and 70–75 u long. The spores have an average length of 45 u and the whole colony corresponds to the Beelian formula 3201: 42.20.

Comparison of a number of specimens of this species from Porto Rico, Santo Domingo and Colombia show that the hyphopodia, and number and size of the appendages are very variable. On this account we are considering the varieties as identical with the species. (Plate XXXII, F).

On *Eupatorium inulaefolium* H. B. K.

CALDAS: Ravines near Armenia, No. *550*, June 19, 1929.

*56. IRENINA GLABRA (B. & C.) Stev., Ann. Mycol. **25**: 461. 1927.
Meliola glabra B. & C., Journ. Lim. Soc. London **10**: 392. 1869.
Irene glabra (B. & C.) Toro, Mycol. **17**: 139. 1925.
On *Randia* sp.

ANTIOQUIA: Medellín, No. *304* (R. A. Toro), Jan. 20, 1928.

*57. IRENINA OBESA (Speg.) Stev., Ann. Myc. **25**: 450. 1927.
Meliola obesa Speg,. Anal. Soc. Cient. Argentina **12**: 72. 1883.
Meliola obesula Speg., Rev. Argentina Hist. Nat. **1**: 27. 1891.
Irene obesa (Speg.) Theiss. & Sydow, Ann. Mycol. **15**: 461. 1917.
On *Zanthoxylon Fagara* (L.) Sarg.

EL VALLE: Near Santa Ana, between Cartago and Cauca river, No. *375*, May 29, 1929.

*58. **Irenina obtusa** Toro sp. nov.

Colonies amphigenous, small, round, black, rarely confluent, 1–2 mm. in diameter; mycelium wavy, septate, brown, branches alternate, cells 16–20 x 5 u; capitate hyphopodia alternate, pyriform, stock cell rectangular, 3 u high, head cell straight, round, about 7 u wide; mucronate hyphopodia rare; perithecia globose, black, rough at the base, 190–220 u in diameter; asci evanescent; spores 4-septate slightly constricted, thick walled, brown, 36–39 x 12–15 u, and cells obtuse. (Plate XXXIII, A).

Formula: 3101: 32.30.

The species differs from the others described in the Rubiaceae in the size of the spores. It resembles *I. penicilliformis* (Gaill.) Stev. in general appearance of the colonies, but differs from it in the perithecia and hyphopodia characters.

On *Tontanea canescens* (Willd.) Standley.

ANTIOQUIA: Angelópolis, No. *221* (R. A. Toro), July 27, 1927 (type).

*59. IRENINA VILIS (Syd.) Stev., Ann. Mycol. **25**: 468. 1927.
Meliola vilis Sydow, Leafl. Phyllippine Bot. **6**: 1926. 1913.
Irene vilis (Syd.) Syd. Ann. Mycol. **15**: 195. 1917.

To this species can be referred the specimens from Porto Rico determined by Stevens (**26**) as *Meliola glabroides* sp. nov. on *Stachytarpheta cayennensis*. The Porto Rican and Colombian specimens have mycelium somewhat bent and the perithecia are of larger diameter than the dimensions given for the Phillippine species. Both, however, correspond to the formula 3101. 32. 20.

On *Valerianodes cayennensis* (L. C. Rich) Kuntze.

ANTIOQUIA: Salgar, No. *367* (R. A. Toro), July 20, 1928.

On *Valerianodes mutabilis* (Jacq.) Kuntze.

TOLIMA: Ravines along Rd. near Ibagué, No. *556*, June 26, 1929.

*60. IRENINA WRIGHTII (B. & C.) Stev., Ann. Mycol. **25**: 450. 1927.
Meliola Wrightii B. & C. Journ. Linn. Soc. London **10**: 392. 1869.

On *Cupania* sp.

CUNDINAMARCA: Along Funza river, trail to Central San Antonio. No. *684*, July 11, 1929.

KEY TO SPECIES OF MELIOLA REPRESENTED IN COLOMBIA:

- **Spores** 3 septate
  - Capitate hyphopodia alternate
    - Spores obtuse *M. nidulans*
- **Spores** 4 septate
  - Mycelial setae dentate
    - Capitate hyphopodia opposite
      - Head cell globose *M. bicornis*
    - Capitate hyphodia alternate
      - Head cell cylindric *M. Mangiferae*
  - Mycelial setae simple
    - Ends acute or rarely bifid
      - Spores acute
        - Capitate hyphopodia alternate *M. Stenotraphi*
    - Ends never bifid
      - Spores obtuse
        - Capitate hyphopodia alternate or opposite *M. pithecolobicola*
        - Capitate hyphodia always alternate *M. Rudolphiae*
    - Ends obtuse
      - Capitate hyphopodia alternate
        - Head cell pyriform *M. Lantanae*
        - Head cell globose *M. integriseta*
        - Head cell lobed *M. Panici.*

*61. MELIOLA BICORNIS Winter, Hedwigia **25**: 99. 1886.
On *Mimosa alba* H. & B.
ANTIOQUIA: Angelopolis, No. *213* (R. A. Toro), July 27, 1927.

*62. MELIOLA INTEGRISETA Speg., Anal. Mus. Nac. Hist. Nat., Buenos Aires **32**: 376. 1924.
Meliola sapindacearum Speg. var. *integriseta* Speg. Anal. Mus. Nac. Hist. Nat. Buenos Aires, **10**: 328. 1909.
Meliola Stevensii Beeli, Bull. Jard. Bot. Bruxelles **7**: 98. 1920.
Meliola integriseta Speg. var *Stevensii* Stev., Ann. Mycol. **26**: 254. 1928.
On *Serjania membranacea* Split.
CUNDINAMARCA: Along Funza river trail to Central San Antonio, No. *687*, July 11, 1929.

63. MELIOLA LANTANAE Sydow, Mem. Soc. Neuch. Sc. Nat. **5**: 434. 1914.

This species agrees in general characters with *M. ambigua* Pat. & Gaill. from which it differs in that a pseudo-ostiolum, as described for the latter, is not present in the Colombian material *M. microspora* Pat. & Gaill. conforms more with the characters of our species but it has much smaller spores. A comparison of the types of these three species will probably show that they are identical and then *M. ambigua* would be the valid name for reason of priority. As probable synonyms can be also added *M. hyptidis* Syd. and *M. cavitensis* Yates.

On *Lantana hispida* H. B. K.
ANTIOQUIA: Angelopolis, No. *226* (R. A. Toro), July 27, 1927.
On *Lantana lilacina* Desv.
EL VALLE: Near Santa Ana, between Cartago and Cauca river, No. *371*, May 29, 1929.
On *Lantana* sp.
TOLIMA: Ravines along Rd. near Ibagué, No. *563*, June 20, 1929.

MELIOLA MANGIFERAE Earle, Bull. N. Y. Bot. Gard. **3**: 307. 1905.
On *Mangifera indica* L.
PANAMA: Panama along Rd. 8 mi. E. of City, No. *187*, April 28, 1929.

*64. MELIOLA NIDULANS (Schw.) Cooke, Grevillea **11**: 37. 1882.
Sphaeria nidulans Schw., Fung. Carol. **1882**: 45.
On *Vaccinum* sp.
ANTIOQUIA: Medellín, No. *247* (R. A. Toro), Sept. 3, 1927.

*65. MELIOLA PANICI Earle, Muhlenbergia **1**: 12. 1901.
On *Panicum* sp.
ANTIOQUIA: La Primavera, Near Medellín, No. *316* (R. A. Toro), Dec, 25, 1927.

*66. MELIOLA PITHECOLOBICOLA Speg. Anal. Mus. Nac. Hist. Nat. Buenos Aires **32**: 371. 1924.
On *Pithecolobium lanceolatum* (H. & B.) Benth.
VALLE: Santa Ana, Near Cartago, No. *373* May 29, 1929.

*67. MELIOLA RUDOLPHIAE Stevens, Illinois Biol. Monog. **24**: 43. 1916.

Although setae and spore characters of our specimens do not fully agree with those given in the original description, we do not feel justified in establishing a new species on this account as observations have shown that these characters are very variable in this particular species. Our specimen shows variations ranging from the Beelian formula 3111 : 42.21 to 3111 : 52.21, while the formula for the species corresponds to 3111 : 52.22.

On Caesalpinaceae.
CUNDINAMARCA: Along Funza river, trail to Heda. San Antonio, Near Apulo, No. *685a*, July 11, 1929.

*68. MELIOLA STENOTAPHRI Stevens, Illinois Biol. Monog. **24**: 41, 1916.
On *Stenotaphrum secundatum* (Walt.) Kuntze.
ANTIOQUIA: Angelopolis, No. *217* (R. A. Toro), July 27, 1927.

Family 2. CAPNODIACEAE

*69. AITHALODERMA LONGISETUM Sydow, Ann. Mycol. **11**: 258. 1913.
On *Coffea arabica* L.
EL VALLE: Bitaco No. *482*, June 11, 1929.

*70. EUANTENNARIA TROPICICOLA Speg., Bol. Acad. Nac. Ci. Córdoba **23**: 187. 1919.
On *Eupatorium tacotanum* Llatt. var. *trineurolopis* Rob.
BOYACÁ: Duitama, No. *560* (R. A. Toro), Jan. 10, 1930.

*71. **Paracapnodium brasilense** (Speg.) char. emend.
Paracapnodium brasilense (Auct., nec. Putt.) Speg. Physis **4**: 288. 1918.
Capnodium brasilense Auct. p. p. in litt.

Fungus epiphyllous, thickly scattered over the leaf surface, sooty black; mycelium dematoid; hyphae branched, sometimes running close together, branches at righ angles, thick-waled, closely septate. forming a continuous chain of rounded toruloid cells 3–4u wide; perithecia solitary, short stipitate, numerous, ovate, 95–100 x 60–70 u, astomous, dehiscing by a longitudinal slit dark colored, composed of small parenchymatic cells 5–7 u in diameter, with 3–7 asci; perithecial stalk formed by a closely interwoven knarl of narrow, septate hyphae, 12–16u high, asci obovate, aparaphysate, short stipitate, 80–88 x 17–22 u, sp. p. 70–80 x 15–20u, 8-spored; spores inordinate, hyaline, club-shaped, muriform, constricted at the middle, thick-walled, 14–27 x 8–12 u.

Pycnidia flask shaped, 200–250 u high, formed by parallel hyphae closely appressed, separating at the top for the dehiscence of the small, oval, one-celled, hyaline pycnospores.

The genus *Paracapnodium* was established by Spegazzini (**24**) with P. *pulchellum* Speg. as type. It differs from *Capnodium* Mont. in the color of spores and in the shape of the perithecia.

Several species of Capnodiaceae have been described on coffee all of them causing the characteristic sooty mold. *Leptocapnodium brasilense* (Putt.) Arn. has transverse septate and is identical with *Capnodium brasilense* Putt. (nec. Auct.); *Aithaloderma longisetum* Sydow possess perithecia with setae and according to Sydow (l. c.) is identical with *Capnodium Coffeas* Pat.; *Phaeosaccardinula costaricensis* (Speg.) Th. and *P. tahitensis* (Pat.) Th. have non-stipitate perithecia with ostiola, while *Limacina coffeicola* Putt. possess non-stipitate perithecia with hyaline, many celled spores.

On leaves of *Coffea arabica* L.

ANTIOQUIA: No. *348* (R. A. Toro), April 10, 1927.

ORDER VI.—PSEUDOSPHAERIALES.

(Rafael A. Toro)

Family I. PARODIELLACEAE

72. EPIPHYMA NEUROPHILUM Theiss, Ann. Mycol. **14**: 404. 1916.

On *Tibouchina* sp.

ANTIOQUIA: Near Medellín, No data. (C. E. Chardon)

*73. PARODIELLA PARAGUAYENSIS Speg., Fungi Guaranitici **1**: 226. 1886.

On *Meibomia purpurea* (Mill) Vail.

ANTIOQUIA: Near Medellín, No. *282* (R. A. Toro), Oct. 15, 1927.

*74. PARODIELLA PERISPORIOIDES (B. & C.) Speg., Anal. Soc. Ci. Argent. **2**: 178. 1880.

Dothidea perisporioides B. & C., Grevillea **4**: 103. 1876.

On *Indigofera suffructicosa* Mill.

ANTIOQUIA: Titiribí, No. *269* (R. A. Toro), August 8, 1927.

On *Meibomia* sp.

ANTIOQUIA: Pto. Berrío, No. *3749* (F. W. Pennell) Jan. 11, 1918.

ORDER VII.—**HYPOCREALES.**

(Carlos E. Chardon)

Family 1—NECTRIACEAE

*75. NECTRIA EPISPHAERIA (Tode) Fr., Summa Veg. Scand. 388. 1845.

Referred to this species although it did not occur, as usual, on old sphaeriaceous fungi. Spores obliquely uniseriate, broad-fusoid, 10–12 x 5–6 u.

On dead bark and roots.

ANTIOQUIA: El Poblado, No. *48*, May 16, 1926; near Fredonia, No. *353* (coll. R. A. Toro) June 18, 1928.

*76. **Nectria Ingae** Chardon sp. nov.

Perithecia sparingly scattered or very seldom in close contact but with no evidence of a stroma, globose with a slightly papillate ostiolum, 170–250 u in diameter, orange in color with the surface slightly granulose but with no hairs; asci cylindrical, 8-spored, 70–85 x 9 x 12 u, with the spores obliquely uniseriate or partially biseriate: spores hyaline, 1-septate, smooth, fusoid, 12–14 x 5 u; paraphyses filiform.

Characterized by numerous, scattered orange perithecia on the outer surface of the pods of the host.

On dead pods of *Inga.*

EL VALLE: Hacienda Bitaco, Cordillera Occidental, No. *469*. June 11, 1929 (type).

*77. **Allantonectria creonectrioides** Chardon sp. nov.

Perithecia in dense, regular caespitose clusters, 8–15 in each, seated on a yellowish stroma; individual perithecia globose, flattened at the top with the ostiolum not prominent, 200–300 u in diameter or more, pale yellow in color, slightly roughened in its surface; asci long cylindrical, 80–90 x 6–8 u, 8-spored with the spores invariably uniseriate; spores 1-celled, hyaline, smooth, fusoid to navicular, with the ends acute, 14–16 x 5–6 u; paraphyses filiform.

Similar in macroscopic characters to a *Creonectria,* but with the spores simple.

On dead bark.

EL VALLE: Hacienda El Hatico, between Cerrito and Palmira, No. *735,* May 23, 1929 (type).

*78. **Creonectria tucumanensis** (Speg.) comb. nov.

Nectria tucumanensis Speg., Myc. Argent, 407. 1909.

The Colombian specimens supplied by Toro agree very well with Spegazzini's description and excellent illustration (loc. cit. fig. 22). The spores are unusually large, 28–36 x 9–11 u, distinctly striate, suballantoid and slightly constricted at the septum. The bright red color of the clusters of perithecia are very characteristic. The papillate ostiola are also very pronounced, but the characteristic brown disk around the region of the ostiolum is lacking in almost all the perithecia. *Creonectria macrospora* Chardon reported from Porto Rico and Venezuela (**22**) is possibly this same species. *Nectria tucumanensis* Speg. has been reported from Costa Rica by Rowlee (**20**).

On bark of *Inga* sp.

ANTIOQUIA: Heliconia, No. *324* (coll. R. A. Toro), May 1, 1928.

On bark of *Albizzia malacocarpa* Stand.

ANTIOQUIA: Heliconia, No. *323* (coll. R. A. Toro), Jan. 18, 1928.

*79. SPHAEROSTILBE COCCOPHILA (Desm.) Tul. Fung. Carp. **1**: 130. 1861.

On scale insects on *Citrus Decumana* L.

EL VALLE: Small grapefruit orchard between Cali and Palmira. No. *227*, May 11, 1929.

*80. MEGALONECTRIA PSEUDOTRICHIA (Schw.) Speg., An. Soc. Ci. Argent. **12**: 82. 1881.

Perithecia in cespitose clusters around the stalked, upright stroma. Spores muriform, hyaline, 28–35 x 7–8 u. A very common species in the American tropics.

On dead bark.

CALDAS: Along Quindio River, near Armenia, No. *726*, July 14, 1929.

*81. GIBERELLA PULICARIS (Fr.) Sacc., Michelia **1**: 43. 1877.

On dead stalks of *Zea mays* L.

EL VALLE: Todos los Santos, along road between Buga and San Pedro, No. *408*, June 4, 1929.

*82. GIBERELLA SAUBINETII (Durien Mont.) Sacc. Michella **1**: 43. 1877.

This fungus was found on an isolated wheat plant growing in a garden at a coffee farm. It is very probable that the wheat seed came up from the United States, with the other vegetable seeds that had been imported for garden use.

On *Triticum aestivum* L.

EL VALLE: Coffee plantation above Pavas, Cordillera Occidental, No. *511*, June 12, 1929.

Family 2—HYPOCREACEAE

83. HYPOCREA RUFA (Pers.) Fr. Summa. Veg. Scand. 383. 1849.

On dead wood and burnt stalks of *Saccharum officiarum* L.

EL VALLE: Hacienda Riopaila, S. Zarzal, Nos. *383* and *539*, May 31 and June 19, 1929, respectively; Hacienda Bitaco, Cordillera Occidental, No. *507*, June 11, 1929.

ORDER VIII.—DOTHIDEALES.

(Carlos E. Chardon)

Special attention has been given by the senior writer to the collecting and study of this large order, so richly represented in tropical regions. The treatment of the order presented in the well-known monograph of Theissen and Sydow (**36**) is invariably followed here, although that work needs a thorough revision and the addition of several hundred species subsequently described.

Theissen and Sydow (l. c.) divided the order into four families: Polystomellaceae, Dothideaceae, Phyllachoraceae and Montagnellaceae. In a subsequent work by these authors (**37**), the Polystomellaceae is removed to the Hemisphaeriales. Of the other three families only two are so far known to occur in Colombia, the Dothideaceae and the Phyllachoraceæ.

Only 30 species of this group are hitherto known to occur in Colombia which is a rather small representation considering the large number of species known from other tropical countries, like Porto Rico and Costa Rica. In the present paper, 53 species are reported, 46 of which were collected in Colombia proper and 7 in Panama. Of the 46 species reported from Colombia, 31 are new additions to Colombia (which more than doubles the number of species so far known) and 13 species are new to science. Nevertheless, the number of Dothideales in the flora of Colombia may be greatly increased in future collections and studies.

The following key will serve to differenciate the families, tribes and genera of Dothideales represented here:

I—Stromata erumpent, dothideaceous

Fam. 1—DOTHIDEACEAE

A—Spores 1-celled	
1—Spores hyaline	1—*Bagnisiopsis*
2—Spores brown	2—*Dothidina*
B—Spores 2-celled	
1—Spores hyaline	
a—Paraphyses present	3—*Uleodothis*
b—Paraphyses absent	4—*Dothidella*
2—Spores brown	5—*Achorella*

II—Stromata subcuticular, subepidermal or in the mesophyll, not dothideaceous

Fam. 2—PHYLLACHORACEAE

A—Stromata subcuticular	Tribe	1—*(Trabutiineae)*
1—Spores 1-celled, hyaline		
a—Paraphyses present		6—*Trabutia*
b—Paraphyses absent		7—*Trabutiella*
2—Spores 2-celled, hyaline		8—*Munkiodothis*
B—Stromata subepidermal	Tribe	2—*(Scirrhiineae)*
1—Spores 1-celled		
a—Spores hyaline		9—*Catacauma*
b—Spores brown		10—*Phaeochorella*
C—Stromata in the mesophyll	Tribe	3—*(Phyllachoriineae)*
1—Spores 1-celled		
a—Spores hyaline		11—*Phyllachora*
b—Spores brown		12—*Sphaerodothis*
2—Spores 4-celled		
a—Spores hyaline		13—*Phragmocarpella*
b—Spores brown		14—*Homostegia*

Family 1—DOTHIDEACEAE.

84. BAGNISIOPSIS TIJUCENSIS Theiss. & Syd., Ann. Mycol. **13**: 291. 1915.

This is a young stage of the fungus, which had been previously reported by Chardon (**5**) on this same host, based on collections made by Toro in Antioquia.

On *Tibouchina longifolia* (Vahl.) Baill.

CALDAS: Ravines near Armenia, No. *543*; June 19, 1929.

*85. **Bagnisiopsis advena** Sydow sp. nov.

Stromata hypophyllous in groups of 2–8 mm, more or less densely disposed, causing yellowish or brownish discolorations on the upper surface of the leaf, obovate or pear-shaped, often very irregular, 300–450 u high, 170–300 u in diameter, at the top broadly rounded, without a distinct ostiolum, opening by an irregular pore, toward the base gradually tapering into a foot-like innate hypostroma, always unilocular; perithecium ovate or pear-shaped, often rregular, the lower half innate into the leaf, the upper half erumpent; perithecium-wall of the lower half 7–10 u thick consisting of several layers of dark brown cells, wall of the upper erumpent half thicker, up to 35 u; asci numerous, clavate, apically broadly rounded, toward the base attenuate, shortly stipitate, 8–spored, sometimes only 4–6 spored, 60–80 u long, 16–30 u broad. Spores obliquely monostichous or incompletely distichous, oblong or oblong-elliptical, broadly rounded, continuous, for a long time hyaline finally greyish-brown or olivaceous-brown, 16–25 u long, 10–12 u broad. Metaphises numerous, broadly filiform 2–3 u broad, soon mucose.

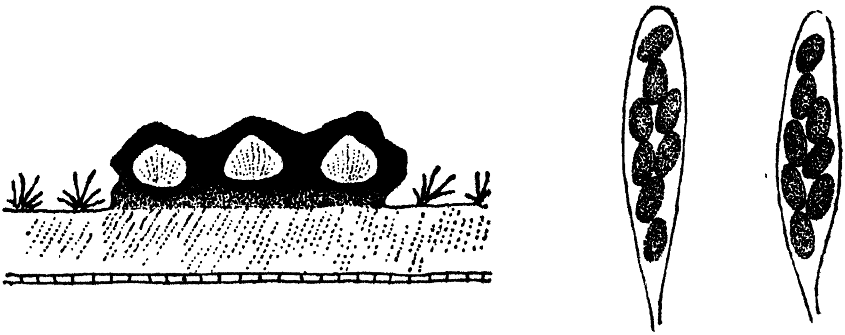

FIG. 4.—DOTHIDINA SCABROSA SYDOW

On *Gynoxis* sp.

CUNDINAMARCA: Cerro Monserrate near Bogotá, No. *612*, June 25, 1929. (type).

*86. DOTHIDINA PERIBEBUYENSIS (Speg.) Chardon, Mycologia **13**: 289. 1922.

Phyllachora peribebuyensis Speg., Anal. Soc. Ci. Argent. **19**: 244 1886.

Auerswaldia Miconiæ P. Henn., Hedwigia **43**: 253. 1904.

A very common and conspicuous species in the American tropics occurring on various Melastomaceæ.

On *Miconia* sp.

EL VALLE: Colegio N. S. de los Andes, Cordillera Occidental, above Cali, No. *443*, June 9, 1929.

DOTHIDINA SCABROSA Sydow, Ann. Mycol. **23**: 284. 1925.*

An abundant collection of this species was made but few stromata were fertile. The spores were 12–14 x 7–8 u, elliptical and slightly olivaceous green. It compares very well with type material (Sydow, fungi exot. exs. *672*) on *Miconia argentea* from Costa Rica.

On *Miconia macrophylla* (D. Don) Triana.

PANAMÁ: Trail near house at Barro Colorado Island, No. *195*, Apr. 29, 1929.

*87. **Uleodothis andina** Chardon sp. nov.

Spots epiphyllous or sometimes amphigenous, not exceeding the stromata; stromata dothideaceous, black, not shiny, warty, consisting of a clustered stroma, which in cross section show 2–5 globose locules, 200–250 x 180–200 u, the whole clustered stroma being attached to the leaf by a base 100–200 u wide, the stromatic base penetrating (hypostroma) deeply in the leaf tissues; asci clavate, 8-spored, with the spores biseriate, 80–100 x 16–20 u; spores 2-celled, hyaline, 28–30 x 4.5–5 u, full of oil drops, the septum not very clearly visible, longfusoid and suballantoid; paraphyses present.

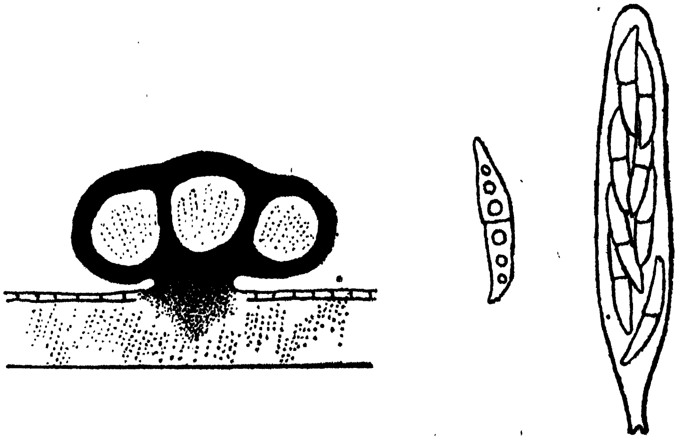

FIG. 5.—ULEODOTHIS ANDINA SP. NOV.

The stroma suggests clearly a *Bagnisiopsis* or a *Dothidina*, but the 2-celled, hyaline spores makes the fungus fall under *Uleodothis*, a genus which is represented in Theissen and Sydow (**36**) by only three species, none of the descriptions of which agree with our Colombian material. (Plate XXXIV, A and fig. 5.)

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* The fungi from Panamá are not included in the numerical order of species, which applies only to the fungi of Colombia treated in this paper.

On *Mikania Ruiziana* Poepp.

EL VALLE: College N. S. de los Andes, Cordillera Occidental above Cali, No. *447 b*, June, 9, 1929 (type).

88. DOTHIDELLA TINCTORIA (Tul.) Sacc. Syll. Fung. **11**: 627. 1883.

This is one of the most conspicuous and common parasitic fungi of the Colombian and Ecuadorian Andean region and was first reported by Tulasne (**40**) on collections made by Triana. Chardon (**4**) again collected and reported it from Antioquia (see pl. 1 fig. 5 of his paper). The identification of this species, however, offers some doubt due to the fact already stated "por el hecho de que existe mucha confusión entre las distintas *Dothidellas* que se conocen sobre *Baccharis.*"

Stevens (**27**) has described *Clypeodiplodina Baccharidis* from Ecuador and has kindly supplied the writer with a specimen which unquestionably is the *Dothidella tinctoria* reported here. Whether the fungus really belongs to the new genus *Clypeodiplodina* or to *Dothidella* is a matter for future study.

On *Eupatorium popayanense* Hieron.

ANTIOQUIA: Parque Independencia, Medellin, No. *248* (coll. R. A. Toro) Sept. 3, 1927; Granizales, No. *291*, (R. A. Toro) Nov. 3, 1927; La Primavera, No. *313* (R. A. Toro) Dec. 25, 1928.

On *Baccharis floribunda* H. B. K.

EL VALLE: Km. 25, Carretera al Mar, Cordillera Occidental, No. *468*, June 10, 1929; along path between Bitaco and La Cumbre, Cordillera Occidental, No. *512*, June 12, 1929.

CUNDINAMARCA: Ravine between Cerro Monserrate and Guadalupe, above Bogotá, No. *614*, June 25, 1929; slopes of Salto de Tequendama, No. *652*, July 6, 1929.

On *Baccharis Lehmannii* Klatt.

ANTIOQUIA: Km. 21, Tranvía de Oriente, No. *62*, May 18, 1926.

*89. DOTHIDELLA PORTORICENSIS Stevens, Bot. Gaz. **69**: 249. 1920.

This is the first report of this species outside of Porto Rico. The specimen compares favorably with the type material.

On *Dicranopteris flexuosa*

EL VALLE: College N. S. de los Andes, above Cali, No. *444*, June 9, 1929.

90. ACHORELLA TOROANA Chardon, Jour. Dept. Agric. Porto Rico **13**: 6. 1929.

The material, although scant, has been compared with the type, which was collected by R. A. Toro in Guarnes, Antioquia on *Cavendishia.*

On *Cavendishia cordifolia* (HBK) Hook.

CUNDINAMARCA: Cerro Monserrate, above Bogotá, (coll. L. M. Murillo) Nov. 15, 1929.

*91. MYRIOGENOSPORA BRESADOLEANA P. Henn., Hedwigia **41**: 9. 1902.

On ***Paspalum conjugatum*** Berg.

EL VALLE: Hacienda Bitaco, Cordillera Occidental, No. *170*, June 10, 1929.

Family 2—PHYLLACHORACEAE.

Tribe 1. TRABUTIINEAE.

*92. **Trabutia calarcana** Chardon sp. nov.

Spots approximately circular, formed in the epiphyll by a large number of small, black stromata which through confluence, form a compound, laberynthiform stroma which becomes very conspicuous, 4–6 mm. in diameter, the spots in the hypophyll are limited to brown discolorations approximately circular; 3–4 mm. in diameter; stromata covering the upper portion of the locule. originating between the cuticle and the epidermis; locules single, elliptical or lenticular, 160–200 x 60–80 u, but becoming very large thru coalescence; asci clavate, 8–spored, with the spores biseriate or inordinate, 48–60 x 18–20; spores 1–celled, hyaline, smooth, elliptical, 12–14 x 5–6 u; paraphyses present. (Plate XXXIV, B and fig. 6.)

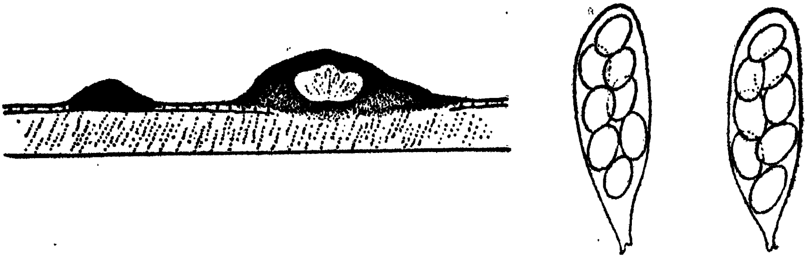

FIG. 6.—TRABUTIA CALARCANA SP. NOV.

This is very distinct in stromatal and spore characters from *Catacauma caracaense* (Rehm) Th. & Syd., on Malphigiaceae from Brazil. It is characterized by its compound laberynthiform stromata on the upper surface of the leaf.

On undetermined species of Malphigiaceae.

CALDAS: Ravines near Calarcá, along Armenia-Ibagué road, No. *706*, July 13, 1929 (type).

Trabutiella Diazii Chardon sp. nov.*

Stromata epiphyllous, black, not shiny, conspicuous, approximately circular, 2–3 mm. in diameter or else very irregular and following the main vein of the leaf, the stroma originating between the cuticle and the epidermis, locules many, usually 3–5, ellipsoidal or irregular thru lateral pressure, 180–250 x 100–150 u, or becoming as large as 500–600 u thru coalescence, bordered at the top by the black stroma; asci clavate, 8–spored, with the spores inordinate, 50–70 x 20–25 u; spores 1–celled, hyaline, smooth, spherical, 8–10 u in diameter; paraphyses absent. (Plate XXXIV, C.)

The absence of paraphyses makes this species fall under *Trabutiella* Theiss. & Sydow (Ann. Mycol. **13**: 359. 1915). The spherical spores are characteristic. Named in honor of Sr. Antonio Díaz, who made possible our excursions and accompanied us to various sections of the country.

On *Machaerium* sp.

PANAMÁ: Finca la Isleta, along road 5 miles E, of Panamá City, No. *177*, Apr. 28, 1929 (type).

*93. **Munkiodothis Hilarionii** Chardon sp. nov.

Spots approximately circular, 8–10 mm. in diameter, amphigenous, very conspicuous in the hypophyll, where it is made up of a flat, spreading stroma, black, but not shiny, roughly circular, 5–6 mm. across and bordered around its circumference by a zone of yellowish tissue, 2–3 mm. across which gradually fades away its yellow color with the green of the healthy leaf tissue, in the epiphyll the spots are of the same size, roughly circular, brown in its central portion and yellowish on its border; stromata originating between the cuticle and the epidermis, unilocular, with the locules flat, 400–500 x 30–40 u, bordered on all sides by the stroma, later coalescing into very large locules over 1 mm. in length and 150–180 u high enclosing asci and paraphyses; asci cylindrical, 8–spored, 80–100 x 10–11 u, with spores uniseriate; spores hyaline, 2–celled, with the upper cell larger than the lower, 16–18 x 7–10 u; paraphyses filiform. (Fig. 7.)

The subcuticular stroma in this species places it in the Trabutiineae of the Phyllachoraceae, while the 2–unlike celled hyaline spores places it under *Munkiodothis*, a rare genus with only one known species *M. melastomata* (v. Hohn.) Th. & Syd., which occurs on Melastomaceae from Java and the Philippines, and from which our species is evidently distinct. Our new species is dedicated to Hermano Hilarion, Director of the "Colegio de Nuestra Señora de los Andes", whose cordial hospitality we had the pleasure of enjoying.

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* See note on page 245.

On undetermined dicotyledonous plant.

El Valle: Colegio N. S. de los Andes, Cordillera Occidental, above Cali, No. *447*, June 9, 1929 (type).

Tribe 2—Scirrhiineae.

*94. Catacauma contractum Sydow, Ann. Mycol. **23**: 365. 1925.

The material has been compared with the type specimen which is Sydow's *273*, on *Gouania tomentosa* Jacq., from near San José,

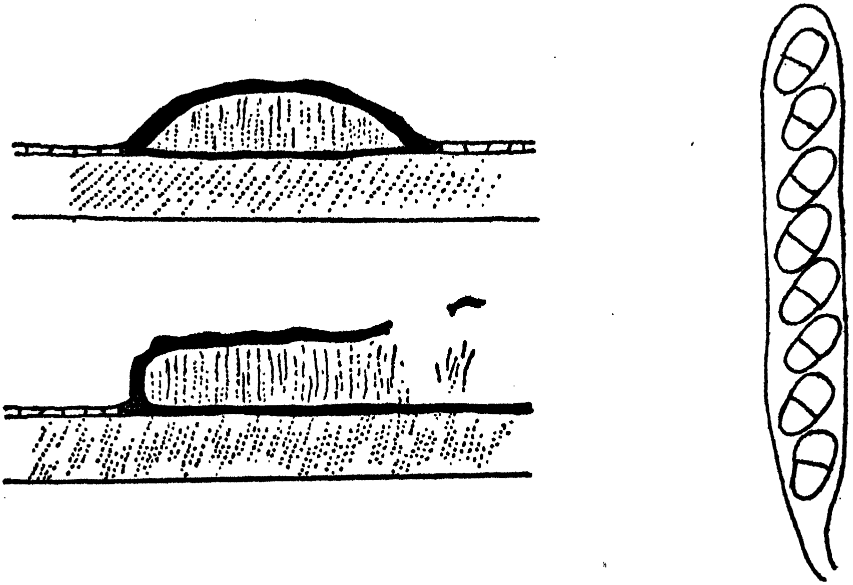

FIG. 7.—MUNKIODOTHIS HILARIONII SP. NOV.

Costa Rica. Spores 9–10 x 4–5 u. *Catacaumella Gouaniæ* Stevens the type of which has been examined occurs on *Gouania* in Costa Rica and the West Indies, has larger spores, 12–17 x 6–9 u.

On *Gouania polygama.*

Antioquia: Near Angelópolis, No. *294* (Coll. R. A. Toro) Jan. 22, 1928.

*95. Catacauma Renalmiae (Rehm) Th. & Syd., Ann. Mycol. **13**: 375. 1915.

Phyllachora Renalmiæ Rehm, Hedw. **36**: 373. 1897.

Agrees with numerous collections made by Stevens in Porto Rico on *Alpinia antillarum.* It has been compared with type material at the herbarium Bureau Plant Industry, Rabenhorst-Pazschke, Fungi europæi et extræeur. *4165*, labelled *Ph. Renalmiæ* Rehm n. sp. on *Renalmia* sp. coll. by E. Ule in Sta. Catharina, Brasil, July 1886.

On *Alpinia* sp.

ANTIOQUIA: Near Salgar, Western Andes, No. *372*, (Coll. R. A. Toro), July 20, 1928.

Catacauma panamensis Chardon sp. nov.*

Spots epiphyllous not larger than the stromata; stromata shining black, conspicuous, epiphyllous, convex, scattered at first, round, about 1 mm. in diameter, becoming confluent later by the coalescence of 3–5 or more stromata, and hence assuming irregular shapes, much less visible in the hypophyll; stromata situated between the epidermis and the mesophyll; asci cylindrical-clavate, 70–82 x 10–15 u, 8-spored with the spores uniseriate, or biseriate in the main body of the ascus; spores blunt ellipsoidal, hyaline, 1-celled, 10–12 x 5–6 u; paraphyses filiform, profuse.

An apparently new species, differing from all known *Catacauma* on *Bauhinia*.

On *Bauhinia* sp.

PANAMÁ: Finca la Isleta, along road 5 m. E. of Panamá City No. *178*, Apr. 28, 1929 (type); Ravine near Orsini's orange grove, at Capira, No. *205*, Apr. 30, 1929.

CATACAUMA RHOPALINUM (Mont.) Theiss. & Syd., Ann. Mycol. **13**: 385. 1915.

Dothidea rhopalina Mont., Syll. Crypt. 222. 1856.

Phyllachora rhopalina Sacc., Syll. Fung. **2**: 595. 1889.

Ph. Roupalæ Rehm., Hedwigia **39**: 234. 1900.

Ph. Rhopalæ P. Henn., Hedwigia **48**: 7. 1908.

This species is reported on the basis of a determination made by Dr. H. Sydow, to whom our specimen was sent and who referred it to *Phyllachora rhopalina* (Mont.) Sacc. Theissen and Sydow (**36**) refer it to *Catacauma*, while Sydow ( ) considers it as a transition form between *Catacauma* and *Phyllachora*. It appears to be a common species on different species of *Roupala* in Cayenne, Perú, Brasil and Costa Rica.

On *Roupala montana* Aubl.

PANAMÁ: Roadside near Chorrera, No. *207*, Apr. 30, 1929 (det. H. Sydow).

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* See note on page 245.

***96. Phaeochorella sphaerospora** Chardon sp. nov.

Spots not exceeding the stromata; stromata epiphyllous, black, shiny, convex, approximately circular, 1–3 mm. across, distinctly situated between the epidermis and the mesophyll; locules several in the stroma, usually 2 or 3, large, flat ellipsoidal or sometimes angular, 300–500 x 150–300 u, bordered on the top by the black, crust-like stroma; asci clavate, 8-spored, 50–65 x 20–25 u, with the spores inordinate; spores 1-celled, with a definite smooth wall and yellow brown contents, spherical, 9–12 u in diam.; paraphyses filiform, inconspicuous. (Fig. 8.)

This is a distinctly *Catacauma*-like fungus, but its yellow brown spores makes it fall under *Phaeochorella*. Its spherical brown spores are specific. Occurring in the same specimen and leaves as *Pseudothis*.

On *Machaerium angustifolium* Vogel.

ANTIOQUIA: Near Salgar, Western Andes, No. *359* (Coll. by R. A. Toro), July 20, 1928 (type).

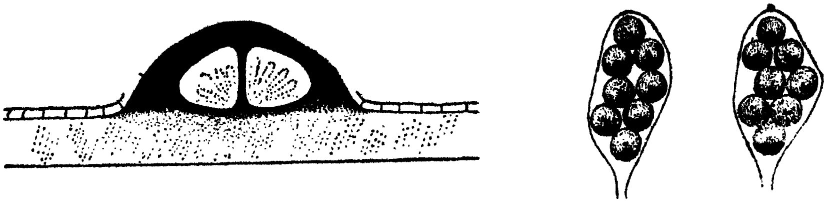

FIG. 8.—PHAEOCHORELLA SPHAEROSPORA SP. NOV.

Tribe 3—PHYLLACHORINEAE.

***97. Phyllachora Molinae** Chardon sp. nov.

Spots amphigenous, yellowish, conspicuous, slightly exceeding the stromata, 2–3 or more mm. long and 1 to 1.5 mm. wide; stromata, black, not shiny, more conspicuous and pronounced in the upper surface of the leaf, globose at first about 1 mm. in diameter, later coalescing and becoming 2–3 mm. long, its length parallel to the main axis of the leaf, 1–3 loculate, with the thicker portion of the stroma bordering the roof of the locules, completely immersed in the mesophyll of the leaf; asci clavate, 8-spored, 70–90 x 14–16 u, with the spores biseriate in the main body of the ascus; spores 1-celled, hyaline, smooth, long elliptical, 14–17 x 4.5 u; paraphyses present.

Differs from *Ph. microspora* Chardon collected and described by the writer from Antioquia, Colombia, in having spores twice as large. It is also different from all other *Phyllachora* on *Paspali*, known to the writer. This species seems to be one of the commonest *Phyllachora* on grasses in the "tierra templada" of Colombia.

The species is dedicated to Dr. Ciro Molina Garcés, the enthusiastic Secretary of Industry of the Department of Valle del Cauca, whose splendid cooperation was a constant stimulus to our work.

On *Paspalum paniculatum* L.

EL VALLE: Hacienda Bitaco, Cordillera Occidental, Nos. *476*, *477* (type) & *487*, June 10–11, 1929; College N. S. de los Andes, Cordillera Occidental, above Cali, No. *463*, June 10, 1929.

CUNDINAMARCA: Granja La Esperanza, No. *585*, June 23, 1929.

PHYLLACHORA MICROSPORA Chardon, Bol. Real Soc. Esp. Hist. Nat. **28**: 119. 1928.*

Spores uniseriate, small, 6–7 x 3 u. Compares very well with the type material. This is the second collection made of this species.

On *Paspalum paniculatum* L.

PANAMÁ: Near Fríjoles R. R. Station, Canal Zone, No. *202*, Apr. 29, 1929.

PHYLLACHORA CORNISPORA-NECROTICA Chardon, Bol. Real Soc. Esp. Hist. Nat. **28**: 116. 1928.

Phyllachora Paspali Earle in herb.

The specimen agrees very well with the type species described and collected by the writer, No. *168*, at Puerto Wilches, along the Magdalena River in 1926. The spores are long-ellipsoidal, biseriate, 15–16 x 4–5 u, with a characteristic slightly curved tip.

In the herbarium of the N. Y. Botanical Garden, the senior writer found a specimen from Porto Rico, Mr. & Mrs. Heller's No. *1381* on *Pasp. virgatum*, Cataño, Mar. 23, 1899, which had been critically studied by the late Prof. F. S. Earle, and regarded as a new (unpublished) species. The description, in Earle's handwriting, reads:

"Stromata amphigenous, scattered, without determinate spots, black, oblong, ends sub-rounded, 1–2 x ½ mm., black within, loeculi few, indistinct. Asci irregularly obovate, 50–60 x 10–6 u. Spores subdistichous, oval, nearly equilateral, continuous, slightly tinted, with a hyaline apiculus at one end, 5–7 u long, spore without apiculus 16–18 x 7 u."

This fits in exactly with *Ph. cornispora-necrotica* Chardon, and a microscopic examination confirmed the identity of the Porto Rican, Colombian and Panamanian material. Unfortunately, no credit can be given here to Earle's species on the basis of priority since it had never been published.

Phyllachora cornuospora Atk. has also beaked spores, 15–17 x

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* See note on page 248.

4–6.5 u. Its type, on *Panicum longifolium* Torr. from Auburn, Ala., was also examined at the N. Y. Botanical Garden, but its stromata are usually uniloculate and macroscopically look different from the tropical species known on *Pasp. virgatum.*

On *Paspalum virgatum* L.

PANAMÁ: Near Fríjoles R. R. Station, Canal Zone, No. *201*, Apr. 29, 1929.

98. PHYLLACHORA PASPALICOLA P. Henn., Hedwigia **48**: 106. 1908.

The type specimen of this species was examined at the herbarium of the Bureau of Plant Industry. It was collected by C. F. Baker in the vicinity of Pará, Brazil on *Paspalum* sp. (evidently not *Pasp. conjugatum*) and distributed as Rehm's Ascomycetes No. *1785*. The stromata are uniloculate and the spores lemon shaped, uniseriate, 10–11 x 5–6 u. The numerous specimens on *Pasp. conjugatum* known to the writer do not seem to essentially differ from Henning's type and are thus referred to that species.

Most of the specimens examined yielded profusely 1-celled, long-fusoid stylospores with acute, sharply curved ends, 21–23 x 2–2.5 u, but a number of stromata, especially in No. *197*, showed numerous asci and spores 10 x 5 u, lemon shaped which compared very well with material from Porto Rico and with Mayor's No. *158*, collected on the same host in Angelópolis, Antioquia. This is one of the commonest *Phyllachora* on grasses in Colombia and Porto Rico.

On *Paspalum conjugatum* Berg.

PANAMÁ: Near house at Barro Colorado Island, Canal Zone, No. *197*, Apr. 29, 1929.

EL VALLE: Finca Las Cañas, S. of Jamundi, No. *278*, May 15, 1929; Hacienda Bitaco, Cordillera Occidental, No. *471*, June 10, 1929.

TOLIMA: El Boquerón, W. of Ibagué long road to Armenia, No. *696*, July 13, 1929.

*99. PHYLLACHORA GUIANENSIS Stevens, Ill. Biol. Mon. **8**: 19. 1923.

The specimen compares well with material collected by Stevens in British Guiana, (No. *712*, from Georgetown): the stromata are surrounded by the characteristic zone of dead host tissue, the spores uniseriate, elliptical, 8–12 x 4–4.5 u. The spots look like those of *Ph. cornispora-necrotica* Chardon which occurs on *Pasp. virgatum* but the spore characters are different.

On *Paspalum virgatum* L.

EL VALLE: Near Buenaventura, No. *213*, May 8, 1929.

On *Paspalum plicatulum* Michx.

EL VALLE: Near Buenaventura, No. *215*, May 8, 1929.

100. PHYLLACHORA MICROSTROMA Chardon, Bol. Real Soc. Esp. Hist. Nat. **28**: 118. 1928.

Stromata characteristically small. Spores 10–12 x 4–5 u, which are slightly larger than the type (No. *139*) which is known from the Magdalena River, near Barranca Bermeja. This is the second collection made.

On *Panicum laxum* Swartz.

EL VALLE: Hacienda el Hatico, between Cerrito and Palmira, No. *345*, May 23, 1929.

*101. PHYLLACHORA INSULARIS Chardon, Jour. Dept. Agric. Porto Rico **13**: 11. 1929.

Stromata multiloculate, epiphyllous, arranged in linear rows parallel to the main axis of the leaf, similar to those of *Ph. Eriochloæ* Speg. Spores 9–10 x 4–4.5 u with blunt ends typical of the species, which was previously known to occur from Porto Rico and Santo Domingo. It seems to be a very common species in these countries.

On *Valota insularis* (L.) Chase.

EL VALLE: Along banks of Cauca River, near Cali, No. *311*, May 21, 1929; dry thickets near San Pedro, N. of Buga, No. *422*, June 4, 1929.

102. PHYLLACHORA PUNCTA (Schw.) C. R. Orton; Stevenson, Jour. Dept. Agric. Porto Rico **2**:153. 1918.

This is one of the most common grass species of *Phyllachora* in Colombia, and in tropical America. Spores 8–10 x 4–5 u, distinctly elliptical, uniseriate. *Ph. Oplismeni* Sydow (Ann. Mycol. **5**: 339 1907) from Costa Rica is probably this same species.

Earle (**8**) reported *Phyllachora graminis* (Pers.) Fckl. on *Oplismenus?* from Santa Marta, Colombia, based on a collection made by C. F. Baker. Baker's specimen was examined at the N. Y. Botanical Garden: the host had subsequently been determined by Mrs. Chase as *Opl. hirtellus* (L.) Beauv. and the fungus is evidently not *Ph. graminis* but the common *Ph. puncta*.

So far as we know, *Ph. graminis* is not present in Colombia. Sydow (**31**) reported *Ph. graminis* in the Mayor collections, but these are now to be referred to either *Ph. puncta* (on *Oplismenus*) or to *Ph. Mayorii* (on *Panicum lanatum*). This last species was described by the senior writer (**4**), after a reexamination of Mayor's specimen.

On Oplismenus hirtellus (L.) Beauv.

EL VALLE: Hacienda El Hatico, between Cerrito and Palmira, No. *347*, May 23, 1929; Colegio N. S. de los Andes, Cordillera Occidental, No. *438*, June 9, 1929; Hacienda Bitaco, Cordillera Occidental, No. *488*, June 11, 1929.

CALDAS: Ravines near Armenia, No. *544*, June 19, 1929.

On *Pseudochinolaena polystachia* (H. B. K.) Stapf.

CALDAS: Along Quindio River, near Armenia, No. 710, July 14, 1929.

103. PHYLLACHORA ERIOCHLOAE Speg. var. COLUMBIENSIS, Theiss. & Syd., Ann. Mycol. **13**: 448. 1915.

The writer is not familiar with the type specimen of *Ph. Eriochloæ* Speg. The determination is based on a comparison with Mayor's No. *158*, collected along the Porce River near Medellin. This was first determined by Sydow (**31**) as *Ph. Eriochloæ* Speg., but Theissen and Sydow (**36**) later gave it the variety named *columbiensis*. The stromata are arranged in linear rows resembling those of *Ph. insularis* Chardon, sometimes 5–8 mm. long, parallel to the main axis of the leaf, spores elliptical, with pointed ends, 10–12 x 4–5 u.

On *Eriochloa punctata* (L.) Desv.

EL VALLE: Along banks of Cauca River, near Cali, No. *322*, May 21, 1929.

104. PHYLLACHORA ANTIOQUENSIS Chardon, Bol. Real Soc. Esp. Hist. Nat. **28**: 188. 1928.

Spores 16–20 x 4–5 u. Agrees very well with the type (No. *76*) which was collected by the senior writer in Sabaletas, Antioquia, on the same host.

On *Imperata contracta* (H. B. K.) Hitch.

EL VALLE: Coffee plantations above Pavas, Cordillera Occidental, No. *508*, June 12, 1929.

105. PHYLLACHORA MAYDIS Maubl., Bull. Soc. Mycol. Fr. **20**: 72. 1904.

A common parasite of corn in tropical America, causing slight damage to the leaves.

On *Zea Mays* L.

EL VALLE: Colegio N. S. de los Andes, Cordillera Occidental, above Cali, No. *534*, June 9, 1929.

CUNDINAMARCA: Yard at Manager's house, Hacienda San Antonio, No. *692*, July 11–12, 1929.

*106. PHYLLACHORA LASIACIS Sydow, Ann. Mycol. **23**: 374. 1925

Compared with a portion of the type material (Sydow No. *203*) from San José, Costa Rica. Spores 12–14 x 4–4.5 u, long navicular. (Plate XXXIV, D.)

On *Lasiacis* sp.

TOLIMA: Along Combeima River, near Ibagué, No. *577*, June 20, 1929.

*107. PHYLLACHORA BONARIENSIS Speg., Fung. Argent. **1**: 185. 1880.

This compares well with the description of *Ph. bonariensis* Speg. reported on *Panicum bambusoides* from Argentine. The stromata are amphigenous, very conspicuous, equally visible on both surfaces of the leaf, black, shiny, 3–4 mm. long x 1 mm. wide, arranged loosely in long linear rows, parallel to the main axis of the leaf, causing yellow longitudinal streaks in the leaves; locules 1–2 in cross section, lenticular or angular on the adjacent sides, 160–200 x 120–150 u, completely immersed in the mesophyll of the leaf, surrounded on all sides by the black stroma; asci cylindrical, clavate, 8-spored with the spores biseriate in the main body of the ascus, 70–95 x 12–15 u; asci 1-celled, hyaline, smooth, long fusoid with pointed ends, 16–18 x 6–7 u; paraphyses filiform, inconspicuous. (Plate XXXIV, F.)

Our material also compares well with a specimen at the N. Y. Botanical Garden from Venezuela labelled "*Phyllachora bonariensis* Speg., sur feuilles vivantes de *Bambusa*, Atures, août." This is part of a series of Gaillard's "Plants du Haut-Orinoque" collected in 1887. The spores measure 17–18 x 7–8 u, and looks to be the same as our Colombian material. The host also looks like *Guadua latifolia*.

Differs from *Ph. gracilis* Speg., reported on a Bambusaceæ from Peribebuy, Brasil, in having slightly smaller spores and very conspicuous linear stromata over twice as long.

On *Guadua latifolia* Kunth.

ANTIOQUIA: Quebrada Sinifaná, No. *93*, May 15, 1926.

EL VALLE: Hacienda El Hatico, between Cerrito and Palmira, No. *346*, May 23, 1929.

*108. **Phyllachora tequendamensis** Chardon sp. nov.

Stromata amphigenous, not shiny, small, .5–1.0 mm. long x .3–.5 mm. wide, equally visible from both surfaces of the leaf, uniloculate or very seldom biloculate; locules globose to ellipsoidal, small,

100–150 x 80–100 u, surrounded on all sides by the black stroma, immersed in the mesophyll; asci cylindrical-clavate, 65–75 x 12–14 u, 8–spored, with the spores biseriate; spores fusoid with acute ends, smooth, hyaline, 1–celled, 14–17 x 6–6.5 u; paraphyses present.

This species is closely related to *Ph. microstroma* Chardon and the stromatic characters are very similar, but the spores are larger. In the former species they are 10–12 x 4–5 u.

On undetermined sp. of Gramineæ.

CUNDINAMARCA: Wet weadows just above Salto de Tequendama, No. *671*, July 6, 1929 (type).

PHYLLACHORA SCLERIAE Rehm, Hedwigia **39**: 232. 1900.*

A common species in the American tropics. Our material is mostly sterile but a few spores, 18 x 5 u were seen, enough to make the determination of the species.

On *Scleria* sp.

PANAMÁ: Road to Pacora, E. of Panamá City, No. *188*, Apr. 28, 1929.

109. PHYLLACHORA AMBROSIAE (B. & C.) Sacc., Syll. Fung. **2**: 601. 1883.

A common species in the Central Andes, previously reported by Sydow (**31**) and also by Chardon (**4**). It is widely distributed in the United States and is also known to occur in Brasil and Argentina.

On *Ambrosia peruviana* Willd.

TOLIMA: Outskirts of Ibagué, No *533*, June 20, 1929.

*110. PHYLLACHORA GALACTIAE Earle; Seaver in Britton, Bahama Flora :633. 1920.

A rather common species, which agrees very well with material from Porto Rico. Spores 20–21 x 5 u. (Fig. 9.)

On *Galactia striata* (Jacq.) Urban.

EL VALLE: Dry thickets near San Pedro, N. of Buga, No. *416*, June 4, 1929; along river at Buga, No. *431*, June 5, 1929.

TOLIMA: Ravines along road near Ibagué, No. *577*, June 20, 1929.

CUNDINAMARCA: Along Funza River, trail to Hacienda San Antonio, No. *683*, July 11, 1929.

***111. Phyllachora Ospinae** Chardon sp. nov.

Stromata amphigenous, black, shiny, conspicuous, equally visible on both surfaces of the leaf, approximately circular, 1.0 to 2.0 mm. in diameter; locules several, large, usually 2 or 3, 300–400 x 170–200 u, completely immersed in the mesophyll and surrounded on all sides by the black stroma; asci cylindrical-clavate, 90–120 x 12–15 u, 8-spored with the spores mostly uniseriate; spores 1-celled, ovoid, 12–14 x 8–10 u, granular and very faintly opaque; paraphyses present. (Fig. 9.)

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* See note on page 245.

This is evidently different in stromatal and spore characters from *Ph. Galactiæ* Earle. The spores are faintly opaque but the species is retained temporarily as a *Phyllachora*. Named in honor of General Mariano Ospina, President of the "Federación Nacional de Cafeteros", who accompanied us to Tequendama Falls.

On *Galactia striata* (Jacq.) Urban.

Cundinamarca: Along slopes of Salto de Tequendama, No. *659*, July 6, 1929 (type).

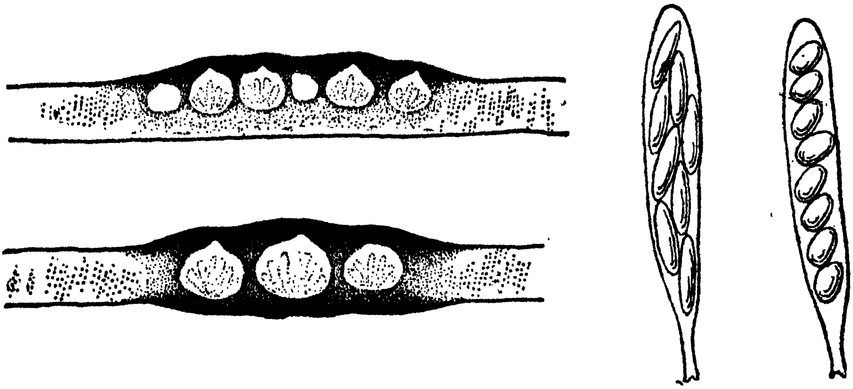

FIG. 9.—UPPER LEAF—PHYLLACHORA GALACTIAE EARLE
LOWER LEAF—PH. OSPINAE SP. NOV.
LEFT ASCUS—PH. OSPINAE SP. NOV.
RIGHT ASCUS—PH. GALACTIAE EARLE

*112. Phyllachora Tragiae (B. & C.) Sacc. Syll. Fung. **2**: 601. 1883.

On *Croton gossypifolius* Vahl.

El Valle: Finca Las Cañas, S. of Jamundi, No. *279*, May 15, 1929; near Toro, No. *535*, June 12, 1929.

Tolima: Outskirts of Ibagué, No. *552 a*, June 20, 1929.

*113. Phyllachora Litseae Koord., Verh. Kon. Akad. Amsterdam, II Sect., Deel. 13. 1907.

The determination of this species, from Java, is not based on comparison with type, but it matches well with a specimen from Panamá

(Stevens No. *1017*) and determined as such by Stevens (Ill. Biol. Monog. **11**: 36). The spores are 14–17 x 4–5 u.

On *Nectandra glabrescens.*

TOLIMA: Ravines along road near Ibagué, No. *559*, June 20, 1929.

*114. PHYLLACHORA PHASEOLI (P. Henn.) Theiss & Sydow, Ann. Mycol. **13**: 507. 1915.

Physalospora Phaseoli P. Henn., Hedwigia **43**: 368. 1904.

Hyponectria Phaseoli Stevens, Bot. Gaz. **70**: 401. 1920.

A conspicuous species characterized by many small, black, punctiform stromata. Spores 10–12 x 8–9 u, usually biseriate.

On *Phaseolus* sp.

ANTIOQUIA: Salgar, Western Andes (Coll R. A. Toro), No. *364*, July 20, 1928.

*115. **Phyllachora Ruelliae** Chardon sp. nov.

Stromata amphigenous, small, approximately circular, about 1 mm. in diam., black, shiny and fairly conspicuous in the epiphyll, dirty black and less visible in the hypophyll; locules 2–3, globose to angular through lateral pressure, 150–200 x 130–165 u, completely immersed in the mesophyll and surrounded on all sides by thick black stromatic tissue; asci cylindrical-clavate, 8–spored, 85–100 x 7–9 u with the spores obliquely uniseriate; spores 1–celled, hyaline to faintly bluish, long elliptical usually tapering at one end, smooth, 22–24 x 5–6 u; paraphyses present.

No species of *Phyllachora* has been reported on this genus, so it is described here as new.

On *Ruellia* sp.

ANTIOQUIA: Fredonia, No. *311* (Coll. by R. A. Toro), Dec. 20, 1927 (type).

*116. PHYLLACHORA TARUMA Speg. Anal. Soc. Ci. Argent. **19**: 94. 1886.

Our material agrees very well with collections from Porto Rico on *Vitex divaricata* and a specimen furnished by the late Dr. C. Spegazzini on *Vitex* (Taruma) from Paraguay.

On *Vitex* sp.

HUILA: Natagaima, Phan. Herb. N. Y. Bot. Garden, No. *260*, (Coll. H. H. Rusby & F. W. Pennell), July 22, 1917.

117. PHYLLACHORA GRATISSIMA Rehm., Hedw. **31**: 306. 1892.

This is a common species in the Andes of Equador and Colombia and is also known from the West Indies. Several collections were reported by Chardon (**3**) from Antioquia. A collection is reported here representing a new locality.

On *Persea gratissima* L.

NARIÑO: Union, no number (Coll. by L. Pardo Navarro), Feb. 1930.

*118. **Phyllachora microtheles** (Speg.) comb. nov.

Puiggarina microtheles Speg., Bol. Acad. Nac. Ci. Cordoba **23**: 125. 1919.

Spegazzini (l. c., 123) created the genus *Puiggarina* to include all those forms of *Phyllachora* possessing uniloculate stromata. The generic standing of the new genus, being rather doubtful, the species is referred to *Phyllachora* as a new combination. A beautiful species, spores 12 x 5 u, comparing very well with Spegazzini (loc. cit.) fig. 335. This is the second collection made of this species, which was only known to occur near Apiahy, Brazil.

On *Chaptalia nutans* (L.) Polak.

TOLIMA: Ravines along road near Ibagué, No. *561*, June 20, 1929.

119. PHYLLACHORA ULEI Winter, Grevillea **15**: 90.

Forming very conspicuous, black shiny, round stromata 2–5 mm. in diameter. Also known from Brazil, Panamá, Costa Rica and Porto Rico.

On undetermined *Dioscoria* sp.

ANTIOQUIA: Near Angelópolis, No. *318* (Coll. R. A. Toro), Jan. 22, 1927; near Fredonia, No. *329* (Coll. R. A. Toro), July 31, 1927.

*120. PHYLLACHORA INSUETA Sydow, Ann. Mycol. **23**: 373. 1925.

This has been compared with a portion of the type material, Sydow's Fung. exot. exsic. *662*, on *Serjania caracasana* Wild. from Grecia, Costa Rica. The macroscopic appearance is not dothideaceous, but sphaeriaceous, due to the fact that the major portion of the stroma is endophyllous and only the beaks of the locules appear on the surface as minute black dots, like in many parasitic Sphaeriales. Spores long-elliptical, 13–16 x 4–5 u. (Fig. 10.)

On *Serjania paniculata* H. B. K.

TOLIMA: Ravines along road near Ibagué, No. *564*, June 20, 1929.

On *Serjania membranacea* Sphlg. ("close to" according H. A. Gleason).

CUNDINAMARCA: Along Funza River, trail to Hacienda San Antonio, No. *688*, July 11–12, 1929.

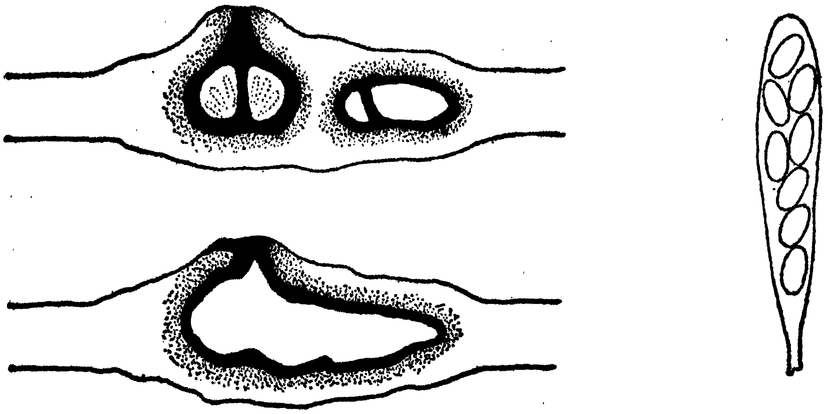

FIG. 10.—PHYLLACHORA INSUETA SYDOW

121. **PHYLLACHORA PERLATA** Sydow, Mem. Soc. Neuch. Sci. Nat. **5**: 436. 1914.

Two independent and abundant collections of this species were made, which was previously known from a single collection made by Mayor (No. *343*) and with which our specimens have been compared. Spores uniseriate, ellipsoidal to ovate, 14–16 x 8–12 u.

On *Polymnia eurylepis* Blake. (Plate XXXV, A.)

CUNDINAMARCA: Ravine between Cerro Monserrate and Guadalupe above Bogotá, No. *613*, June 25, 1929.

On *Polymnia* sp.

ANTIOQUIA: Salgar, Western Andes, No. *358* (Coll. R. A. Toro), July 20, 1928.

*122. **PHYLLACHORA AEQUATORIENSIS** Theiss. & Sydow, Ann. Mycol. **13**: 521. 1915.

Ph. dendritica Rehm, Hedwigia **31**: 305. 1892.

This is a beautiful and conspicuous species, previously reported from Ecuador by Rehm (Ascom. No. *1072*) on the same host. Spores are elliptical to ovate, a little larger than the original diagnosis, 10–14 x 7–10 u. It compares well with a specimen in the Bureau of Plant Industry, collected by F. L. Stevens (No. *281*) in Ecuador on *Monnina salicifolia* and labelled *Ph. aequatoriensis* Th. & Syd. The type material from Ecuador has been examined at the New York Botanical Garden.

On *Monnina* sp.

El Valle: Hacienda Bitaco, Cordillera Occidental, No. *489*, July 11, 1929.

Cundinamarca: Slopes at Salto de Tequendama, No. *658*, July 6, 1929.

*123. **Phyllachora Toroi** Chardon sp. nov.

Stromata amphigenous, black, shiny, circular, 1–1.5 mm. in diameter, concave and more pronounced in the under-surface, slightly less so in the upper surface, embedded in the mesophyll; locules single or double, ovate or elliptical, large, 250–350 x 170–200 u, completely surrounded by the black stroma; asci cylindrical, 8–spored, 90–105 x 12–14 u, with the spores obliquely uniseriate; ascospores 1-celled, hyaline, elliptical smooth, 10–16 x 9–10 u, granular inside; stylospores spindleform 18–20 x .5 u; paraphyses present. (Plate XXXV, D and fig. 11.)

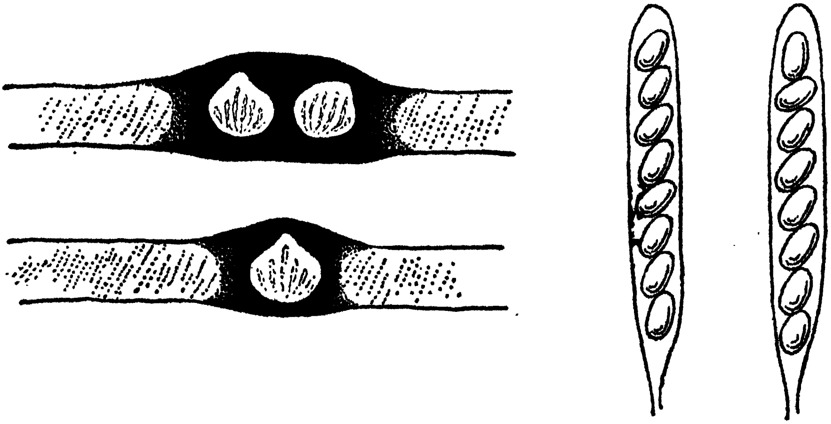

FIG. 11.—PHYLLACHORA TOROI SP. NOV.

Phyllachora Cestri Pat. (Bull. Soc. Myc. Fr. 7: 176) reported on *Cestrum* from Quito, Ecuador, has spores irregularly biseriate in the ascus, 20–23 x 7–9 u. Its stromatal characters are also different from our species, which is apparently new.

Dedicated to my collaborator Mr. R. A. Toro, who during the past three years, has made important phanerogamic and mycological collections in Colombia.

On *Cestrum parviflorum* Duval.

Boyacá: Duitama, No. *404* (Coll. R. A. Toro), Feb. 20, 1920 (type).

CUNDINAMARCA: Near Bogotá, Phan. Herb. N. Y. Bot. Garden No. *2349*, (Coll. F. W. Pennell) Oct. 4–8, 1917; Chapinero, Sabana de Bogotá, No. *553*, (Coll. R. A. Toro) Sept. 18, 1929.

*124. **Phyllachora Guazumae** P. Henn. chart. emend.
Phyllachora? Guazumae P. Henn. Hedwigia **48**: 7. 1908.
Trabutia Guazumae Chardon, Mycologia **13**: 291. 1921.

Stromata epiphyllous, numerous, black, shining, approximately circular, distinctly convex, 1–2 mm. in diameter, in rare cases 3 mm. across, surrounded by a discolored zone of dead host tissue; locules many, generally 3–5, globose, 200–300 u, immersed in the mesophyll of the leaf, bordered on the top by a heavy black stroma, and on the sides and below by faint stromatic tissue; asci subcylindrical-clavate, 63–85 x 13–15 u, 8–spored, with the spores uniseriate, or more commonly, biseriate; spores long-elliptical, 1–celled, hyaline, 18–20 x 4–5 u, with guttulate contents; paraphyses present.

The senior writer (**2**) in 1921, collected specimens of this species in Porto Rico, which he named *Trabutia Guazumae* sp. nov., although he admitted that "this form is probably coespecific with *Phyllachora Guazumae.*" Henning's description is incomplete, and since it seems that both the Porto Rican and the Colombian material belong together, an amended description of the species is made here. It falls under *Phyllachora* more properly than in *Trabutia*. The species has also been collected in Panamá, Cuba and Santo Domingo.

A specimen has been seen at the herbarium Bureau of Plant Industry which macroscopically looks identical with this species. It is labelled *Dothidea rhytismoides* B. & C., coll. C. Wright, presumably from Nicaragua (?) on leaves which look like *Guazuma*. The material is very old (1853–56) and did not show spores.

On *Guazuma ulmifolia* Lam.

EL VALLE: Dry thickets near San Pedro, N. of Buga, No. *419*, June 4, 1929.

*125. **Phyllachora vallecaucana** Chardon sp. nov.

Stromata amphigenous, black, not shiny, conspicuous, equally visible on both surfaces, some of them approximately circular, others angular and irregular, 1–2 mm. across; locules several, 2–5 in each stroma, lenticular or slightly angular thru lateral pressure, completely immersed in the mesophyll and surrounded on all sides by the black stroma, 170–250 x 150–180 u; asci cylindrical-clavate, 75–95 x 10–12 u, 8–spored with the spores obliquely uniseriate; spores 1–celled, hyaline, ovate, smooth, 8–10 x 4–5 u; paraphyses present. (**Plate XXXV, E and fig. 12.**)

There being no Phyllachoraceæ reported on the host genus, the species is considered new.

On *Buettneria* sp.

El Valle: In forests at Hacienda Riopailla, S. of Zarzal, No. *381*, May 31, 1929 (type).

*126. **Sphaerodothis columbiensis** Chardon sp. nov.

Stromata amphigenous, black, not shiny but conspicuous, equally visible from both surfaces of the leaf, 1.0–1.5 mm. long, and 0.7 to 1.0 mm. wide, the longer dimension parallel to the main axis of the leaf, sometimes coalescing and reaching a length of 2–3 mm.; locules generally 2 or 3 in the stroma, which covers them on all sides and is immersed in the mesophyll of the leaf; locules long ellipsoidal, flattened or even irregular, large, 150–320 x 120–170 u; asci cylindrical to cylindrical-clavate or clavate, depending on the arrangement of the spores, which may be uniseriate, partially biseriate or even inordinate, 75–92 x 15–18, 8–spored; spores elliptical with blunt ends, 1–celled, light brown in color, 15–18 x 7–8 u; paraphyses present. (Plate XXXIV, fig. E.)

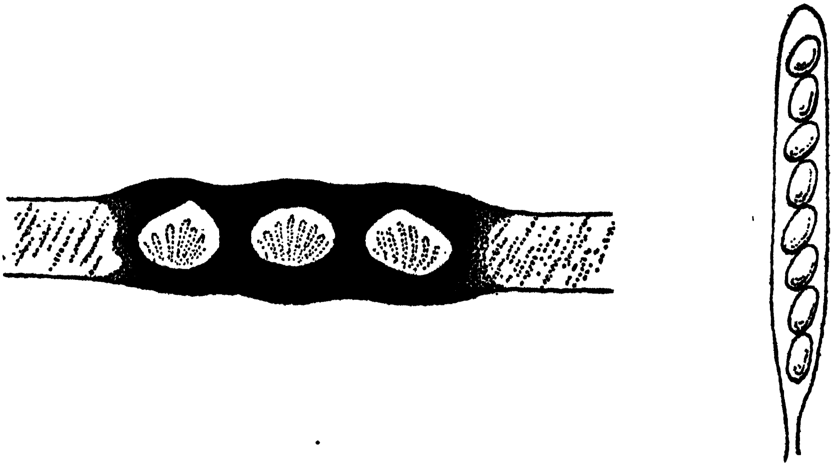

FIG. 12.—PHYLLACHORA VALLECAUCANA SP. NOV.

A very distinct form, there being no species of *Sphaerodothis* previously reported on *Pennisetum*.

On *Pennisetum bambusiforme* (Four.) Hemsl.

Caldas: Ravines near Calarcá, Ibagué-Armenia road, No. *705*, July 13, 1929 (type).

CUNDINAMARCA: Along road beyond Salto de Tequendama, No. *676*, July 7, 1929.

127. SPHAERODOTHIS ANTIOQUENSIS Chardon, Jour. Dept. Agric. Porto Rico **13**: 13. 1929.

The host of this species was erroneously reported at *Arthrostylidium*, while a new host determination by Dr. A. S. Hitchcock is given here.

On *Chelonanthus acutangulus* (R. O. P.) Gilg.

ANTIOQUIA: Santiago, No. *284* (Coll. R. A. Toro) Nov. 13, 1927.

128. PHRAGMOCARPELLA PUIGGARI (Speg.) Theiss. & Syd., Ann. Mycol **13**: 602. 1915.

Montagnella? Puiggari Speg. Fungi Puigg. No. 530.

The stromata are very minute, amphigenous, 2–3 loculate, *Phyllachora*-like; asci 60–70 x 6–8 u, 8–spored, with the spores biseriate: spores fusoid, 3–septate and 4–guttulate, hyaline, 15–17 x 4–4.5, paraphyses absent.

Spegazzini's type has not been seen but its description fits very well our material. It is known from Apiahy, Brazil on *Oplismenus* sp., and has been reported from Costa Rica by Stevens (Ill. Biol. Monog. **11**, No. 2: 44) on *Opl. burmanni.* Dr. Eug. Mayor made a collection (No. *221*) along the road from Medellín to Bello, Antioquia, on *Opl. setarius* (Lam.) R. S., which Sydow (**31**) has already referred to this species, so our collection is the second known from Colombia.

On *Panicum laxum* Swartz.

EL VALLE: Near Buenaventura, No. *218*, May 8, 1929.

*129. **Homostegia Ischaemi** Chardon sp. nov.

Stromata amphigenous, black, not shiny, scattered, very conspicuous in the upper surface of the leaf, much less so in the undersurface, round, about .7–1.0 mm. in diam., immersed in the mesophyll; locules generally 2–3, large, 200–300 x 80–120 u, bordered by black a stroma on the upper portion and slightly so along the sides and bottom; asci cylindrical-clavate, numerous, 54–65 x 10–12 u, 8–spored, with the spores biseriate; spores at first 2–celled, hyaline, with granular contents, long-elliptical, 12–14 x 3–4 u, at maturity becoming 4–celled, distinctly brown, 15–18 x 3–4 u; paraphyses present.

A rare and distinct form.

On *Ischaemum latifolium* (Spr.) Kunth.

EL VALLE: Near Buenaventura, No. *214*, May 8, 1929 (type).

ORDER IX.—FIMETARIALES.

Family I. CHAETOMIACEAE

*130. CHAETOMIUM GLOBOSUM Kunze & Schm., Myk. Hefte 1:15. 1817.

On wet paper.

CUNDINAMARCA: Bogotá, No. *563* (R. A. Toro), March 20, 1930.

ORDER X.—SPHAERIALES.

(CARLOS E. CHARDON)

Family I. MYCOSPHAERELLACEAE

131. MYCOSPHAERELLA DRYMARIAE Sydow, Mem. Soc. Neuch. Sci. Nat. 5:435.

The specimen is referred here, although the material is not fully ripe, and the type material has not been examined. Perithecia hypophyllous, globose, small, 60–70u in diameter. Known from a single collection by Mayor (No. *260*), on the same host, from Antioquia.

On *Drymaria cordata* (L.) Willd.

EL VALLE: College N. S. de los Andes, Cordillera Occidental, No. *460*, June 10, 1929.

*132. **Sphaerulina ferruginosa** Chardon & Toro sp. nov.

Spots several in each leaf, yellowish on the upper surface, dark on the lower, somewhat irregular, center raised, black in hypophyllous spots, 0.25–1 mm. in diameter, margin cream; perithecia single or several in the spot, hypophyllous, black, globose, composed of short, septate, an astomosing, dark brown hyphae, 2–3 u thick, sometimes confluent, immersed at first, later errumpent, sub-epidermal, 110–115 x 110–132 u in diameter; superficial mycelium none; internal mycelium septate, intercellular, hyaline; ostiolum short, papillate, 20–30 u wide; asci fascicuate, clavate, slightly curved or straight, short pedicellate, thick-walled, dehiscing by a pore, 8-spored, 80–85 x 16–20 u; spores inordinate or biseriate 5–7 septate, thick-walled, not constricted, hyaline 19–22 x 7–8 u; paraphyses none.

The species resembles *Sphaerulina microthyrioides* Rehm in the general character of the perithecia, but differs from it in having larger asci, of different shape, and in the absence of paraphyses. From S. *subtropica* Speg. in the septation of the spores and size of perithecia, asci and spores. No. *641* is heavily parasitized an undetermined Hypocreaceous fungus.

On *Chusquea scandens* Kunth.

Cundinamarca: Ravines between Cerro Monserrate and Guadalupe, above Bogotá, No. *603*, June 25, 1929. (type); slopes of Salto de Tequendama, No. *641*, July 6, 1929.

Family 2. Pleosporaceae

133. Leptosphaeria Sacchari van Breda de Haan, Meded. Proof. Suik. West-Java 1892: 5. 1892.

On *Saccharum officinarum* L.

Widespread in all the sugar producing countries of the world as causing the "ring-spot" disease of the leaves.

Panamá: Plant Introduction Garden, Summit, Canal Zone, No. *189*, Apr. 29, 1929.

El Valle: Near Rozzo, N. W. of Palmira, (coll. J. A. B. Nolla) No. *394*, May 31, 1929.

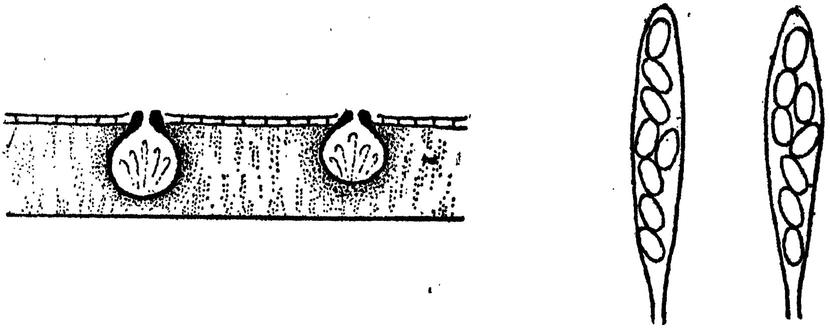

FIG. 13.—CLYPEOTRABUTIA MONTSERRATIS SP. NOV.

Physalospora Andirae Stevens, Trans. Ill. Acad. Sci. **10**: 184. 1917.

On *Andira inermis* H. B. K.*

Previously known from Porto Rico and Santo Domingo.

Panamá: Finca La Isleta, 5mi. E. of Panamá City, No. *179*, Apr. 28, 1929; Ravine near Capira, No. *206*, Apr. 30, 1929.

Family 3. Gnomoniaceae

134. Gnomonia Ospinae Chardon, Bol. Real Soc. Esp. Hist. Nat. **28**: 120. 1928.

On *Tecoma spectabilis* Planch.

This is the second collection recorded of this species.

Antioquia: Medellín, No. *198* (coll. R. A. Toro) Apr. 4, 1927.

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* See note on page 245.

Family 4. CLYPEOSPHAERIACEAE

*135. **Clypeotrabutia montserratis** Chardon sp. nov.

Spots approximately circular, 3–5 mm. in diameter, yellowish with definite borders, epiphyllous, spotted with many (20–50) minute black dots which are the clypei of the perithecial necks; perithecia globose, single, 200–250 x 150–200 u, possessing true perithecial walls, entirely immersed in the leaf tissues; ostiole central, opening and slightly protruding in the epiphyll, bordered by a conspicuous, black clypeus; asci cylindrical-clavate, 8-spored, 90–100 x 14–16 u, with the biseriate in the main body of the ascus; spores 1-celled, hyaline, elliptical, smooth, 10–12 x 5–6 u; paraphyses present. (Plate XXXV, C and fig. 13.)

Seaver and Chardon (**22**) erected the genus *Clypeotrabutia* to take care of the 1-celled, hyaline-spore forms of the family Clypeosphaeriaceae. of the Sphaeriales. In Engler und Prantl's keys for the family, such forms were received under *Trabutia* Sacc. & Roum. but this genus has been transferred by Theissen und Sydow (**36**) to the Phyllachoraceae of the Dothideales.

The species clearly falls under *Clypeotrabutia,* with the conspicuous black clypeus around the ostiolum as a distinctive character.

On *Parseola coerula* (L. f.) Macbr.

CUNDINAMARCA: Ravine between Cerro Monserrate and Guadalupe, above Bogotá, No. *597*, June 25, 1929. (type).

*136. **Clypeotrabutia medellinensis** Chardon sp. nov.

Spots approximately circular, 5–8 mm. in diameter, faintly discolored and inconspicuous in the epipyll, slightly more so in the hypophyll where a large number of small, punctiform, convex perithecia may be seen, with the black clypei clearly visible; perithecia globose or slightly flattened, 180–210 x 130–165 u in diam., possessing true perithecial walls, completely immersed in the mesophyll, greatly convex in the hypophyll where the ostiole is found surrounded by a distinct clypeus of stromatic tissue; asci cylindrical-clavate, 8-spored, 80–90 x 13–14 u, with the spores biseriate in the main body of the ascus; spores 1-celled, faintly bluish to hyaline, long elliptical, tapering at one end, 24–26 x 6–7 u, smooth; paraphyses present.

A beautiful species with the hand lens showing many densely packed punctiform perithecia in the undersurface of the leaf.

On *Trichanthera gigantea* (H. B. K.) Nees.

ANTIOQUIA: Near Medellín, No. *188*, (coll. by R. A. Toro), June 3, 1927 (type); Medellín, No. *283* (col. by R. A. Toro), Oct. 15, 1927.

DIATRACTIUM CORDIAE (Stevens) Sydow, Ann. Mycol. **18**: 183. **1920.**
Trabutiella Cordiae Stevens, Bot. Gaz. **70**: 401. 1920.
On *Cordia glabra* L.
Previously known only from Porto Rico.
PANAMÁ: Along read, 8mi. E. of Panamá City, No. *180*, Apr. **28**, 1929.

Endotrabutia Chardon gen. nov.

Perithecia entirely immersed in the host tissue, never protruding, provided with true perithecial wall, bordered at the top with a clearly marked clypeus formed of black, stromatic tissue; asci cylindrical-clavate, 8-spored; spores 1-celled, brown, provided with a conspicuous gelatine envelope; paraphyses present.

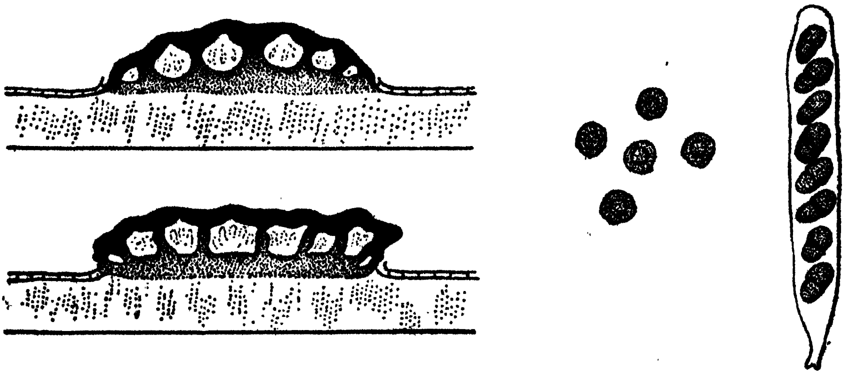

FIG. 14.—PSEUDOTHIS SUBCOCCODES (SPEG.) THEISSEN
(Cross sections of leaf, conidia and an ascus)

Type species: *Endotrabutia tequendamensis* sp. nov.

This new genus falls in the true Clypeosphaeriaceae, due to its well defined clypeus bordering the upper portion of the perithecium. Its strictly endogenous nature, however, is unique, and separates it from its closes relative *Anthostomella* Sacc., which takes care of all the 1-celled, brown spored species of that family. The characteristic gelatine envelope of the spores suggest the Massariaceae, but in this family, the perithecia are carbonous or thick coriaceous. The erection of this genus seems justifiable at present.

*137. **Endotrabutia tequendamensis** Chardon sp. nov.

Spots amphigenous, punctiform, black, less than 1 mm. in diameter, with the long axis parallel to length of leaf, crowded in colonies (20–30); perithecia entirely immersed in the host tissue, provided with walls, angular and even quadrilateral in shape, 175–280 x 130–165 u, provided with a characteristic black clypeus which connects the perithecium with the upper and lower epidermis; asci cylindrical-clavate, 8–spored, with the spores biseriate in the main body of the ascus: spores large, 1–celled, yellowish brown, 25–28 x 910 u, surrounded by a hyaline gelatinous envelope, 1.5–2 u thick; paraphyses present.

On *Cortaderia radiuscula* Stopf.

CUNDINAMARCA: Slopes of Salto de Tequendama, No. *642*, July 6, 1929. (Type).

*138. PSEUDOTHIS SUBCOCCODES (Speg.) Theiss., Anal. Mycol. **16**: 182. 1918.

Rousoella subcoccodes Speg. Fung. Puig. **1**: 549.
Munkiella pulchella Speg. Syll. Fung. **9**: 1035.
Dothidella Machaerii Rehm., Hedwigia **36**: 377. 1897.
Cocconia Machaerii P. Henn., Hedwigia **41**: 112. 1902.
Dothidea machaeriophila P. Henn., Hedwigia **43**: 256. 1904.
Dothidella machaeriophila Sacc., Syll. Fung. **17**: 847.

The nomenclature of this interesting species is somewhat confusing. At first the writers thought his was a *Systremma*, but the specimen was sent to Dr. H. Sydow, who based on the paper of Theissen (**38**) determined it as *Pseudothis machaeriophila* (P. Henn.) Th. Later, an examination at the N. Y. Botanical Garden of Rabenhorst-Winter No. 3460, labelled *Munkiella pulchella* Speg. from Sao Francisco, Brazil (coll. E. Ule in 1885) proved to be the same fungus. In Theissen and Sydow (**36**), *Munkiella pulchella* is considered as a synonym of *Rousoella subcoccodes* Speg. (Fig. 14.)

On *Machaerium angustifolium* Vogel.

ANTIOQUIA: Near Salgar, Western Andes, No. *359* (coll. R. A. Toro), July 20, 1928.

Family 4.—XYLARIACEAE.

J. H. MILLER *

The Xylariaceae of Colombia are very imperfectly known, and only about twenty species have been reported by various previous investigators. The present study of the collections made by C. E. Chardon and R. A. Toro representing 18 species has been interesting, and has resulted in reporting 13 species new to the flora and one new combination. The genus *Rosellinia* is included in the family as a result of the author's previous work (**18**).

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* Contribution from the Department of Botany, University of Georgia.

*139. ROSELLINIA BUNODES (B. & Br.) Sacc., Syll. Fung. **1**: 254. 1882.

Both stages of the *Rosellinia* were found. The perfect stage, No. *522*, was overripe and did not show spores, but the large, black, warty perithecia were typical. The determination of the species was made by C. E. Chardon who reports that the fungus was associated with a coffee root disease causing considerable damages in the plantations at Bitaco, Pavas and la Cumbre.

On base of stem and roots of *Coffea arabica* L.

EL VALLE: Hacienda Bitaco, Cordillera Occidental, No. *504* (*Dematophora* stage), and No. *522* (perfect stage), June 11, 1929.

*140. ROSELLINIA DESMAZIERII (B. & Br.) Sacc. var. ACUTISPORA Theiss., Ann. Mycol. **6**: 350. 1908.

The specimen is old but agrees very well with Theissen's type. The type of subiculum found here is quite similar to that found in *R. aquila* (Fr.) de Not., but the perithecia are much larger.

On dead wood.

ANTIOQUIA: near Salgar, Western Andes, No.—— (coll. R. A. Toro), 1927.

*141. HYPOXYLON CHUSQUEAE P. Henn., Hedw. **39**: 138. 1900.

This fungus was first determined by the writer as *H. cohaerens* (P.) Fr. and reported as such by Chardon (**4**). Lately, a second examination has been made: the ascospores measure 11–15 x 5–7 u. The external appearance of this specimen is very similar to *H. cohaerens*, but the ascospores are much larger. *H. Chusqueae* as described by Theissen (**33**) is similar to this specimen, but it is white inside.

On dead bark of fallen tree.

ANTIOQUIA: Ravine at finca Sorrento, near El Poblado, No. *47*, May 16, 1926.

*142. HYPOXYLON MULTIFORME Fr., Summ. Veg. Scand. 384. 1849.

Ascospores 9–10.5 x 3.5–5 u. This is typical of the effused form found in North America and Europe. It resembles a form of *H. rubiginosum*, but the papillate ostiola rule that species out.

On dead wood.

EL VALLE: Hacienda El Hatico, between Cerrito and Palmira, No. *363*, May 23, 1929.

143. HYPOXYLON MARGINATUM (Schw.) Berk., Grevillea **4**:49. 1875.

Sphaeria marginata Schw. Syn. North Amer. F. No. 1176. 1832.

Ascospores 9–10 x 3.5–5 u. This form of *H. marginatum* has been called *H. annulatum*, but Dr. Shear (**23**) says, "*H. annulatum* (Schw.) Curt. equals an effuse form of *H. marginatum* (Schw.) Berk." This species was first reported from Colombia by Leveille (**14**).

On dead wood.

TOLIMA: El Boquerón W. of Ibague along Armenia Road, No. *699*, July 14, 1929.

144. HYPOXYLON SERPENS Pers. Fr., Summa Veg. Scand. 384. 1849.

Sphaeria serpens Pers. Syn. F. 20. 1801.

Ascospores 12 x 6 u. This specimen is very close to *H. colliculosum* (Schw.) Nits., but the specimen at Kew and also the Morgan specimen under that name approach *H. serpens* so closely that I believe the two names are synonymous. This species was also reported from Colombia by Leveille (**14**).

On dead wood.

CALDAS: Along Quindio R. near Armenia, No. *727*, July 14, 1929.

*145. **Hypoxylon rubigineo-areolatum** Rehm. var. **Bakeri** (Earle) comb. nov.

Hypoxylon Bakeri Earle, Bull. Torr. Bot. Club **26**:633. 1899.

Hyp. rubigineo-areolatum Rehm var. *microspora* Theiss., Ann. Mycol. **6**:345. 1908.

The name going with the earlier date (1899) should be used. This form is close to *H. multiforme* Fr. from which it differs in the smaller perithecia and slightly larger spores. The areolate character surrounding each ostiolar neck is seen only in specimens with very compact perithecia.

On dead branch.

MAGDALENA: Near Bonda (coll. C. F. Baker) Dec. 1898 (specimen at N. Y. Bot. Garden).

*146. NUMMULARIA COMMIXTA Rehm., Hedwigia **44**:6. 1905.

A few spores were found which would place this specimen in *N. Pezizoidea* P. Henn. rather than *N. commixta*, but Dr. Diehl determines it as *N. commixta* and says it agrees with the Theissen f. brasil No. *112* and Rick's F. Austro-Amer. No. *309*; however, as he found no ascospores this specimen cannot be determined accurately.

On dead wood.

El Valle: Hacienda El Hatico between Cerrito and Palmira, No. *364*, May 23, 1929.

NUMMULARIA BULLIARDI Tul., Sel. Carp. **2**: 43. 1863.

This species according to Miller is *H. nummularium* Bull. since he places the species under the name of *Nummularia* back in *Hypoxylon*. Spores 10–12 x 5–6 u.

On dead wood.

Panamá: Barro Colorado Island, No. *194*. April 29, 1929.

147. DALDINIA CONCENTRICA (Bolt.) es. & de Not., Comm. Critt. Ital. **1**: 198. 1863.

On dead wood.

El Valle: Hacienda Riopaila, S. of Zarzal, No. *393*, May 31, 1929; Finca El Hatico, between Cerrito and Palmira, No. *732*, May 22, 1929: Forests near San Pedro, N. of Buga, No. *737*, June 4, 1929.

148. PORONIA CEDIPUS Mont., Syll. Crypt. 209. 1856.

On horse dung.

El Valle: Vicinity of Cali, No. *730*, May 18, 1929.

*149. CAMILLEA CYCLOPS Mont., Syll. Crypt. No. *705* & Cent. *2*, No. 41. 1856.

Only two previous collections of this species are known according to Lloyd (**16**): one from the Leprieur collection from French Guiana, and another collected by Rev. Torrend from Brasil. (Plate XXXV, F.)

On bark of fallen tree.

El Valle: Coffee grove near R. R. Station at Bitaco, Cordillera Occidental, No. *937*, June, 11, 1929. (det. by W. H. Diehl).

*150. CAMILLEA GLOBOSA (Lev.) Lloyd, Myc. Notes: 8–9. 1917.

Phylacia globosa Lev. Ann. Sci. Nat. III, **3**: 61–62. 1845.

It is with some hesitancy that the specimen is referred here. Lloyd says that Leveille's specimen came from Tolima, Colombia. *Camillea poculiformis* (Kunze) which is figured by Lloyd appears to be a stipitate form of *C. globosa*, but in our specimen, plants with and without stipes are found. (Plate XXXV, B.)

On bark of fallen tree.

El Valle: Coffee grove near R. R. Station at Bitaco, Cordillera Occidental, No. *740*, June 11, 1929.

*151. XYLARIA COMOSA Mont., Syll. Crypt. No. 696 and Cent. 2, No. 30. 1856.

According to Theissen this is a very common species in South America. There are no ascospores, but at the apex of the conidial stroma the *Isaria* growth is a form commonly found on this species. See Ann. Myc. **7**: tab. 8, Fig. 1, 1909.

On dead wood.

SANTANDER: Along banks of Magdalena river, across Puerto Berrío, No. 132, June 15, 1926.

*152. XYLARIA HYPOXYLON (L.) Grev. Fl. Edin. 355. 1824.

Clavaria hypoxylon L. Sp. Pl. 1182. 1753.

The branched stroma, puberulent base, and ascospores (12–15 x 5–7 u) places this definitely.

On dead wood.

SANTANDER: Magdalena River near Puerto Wilches, No. *155*, 1926.

*153. XYLARIA RHIZOCOLA Mont., Syll. Crypt. No. *684* and Cent. *2*, No. *28*. 1856.

This specimen was incorrectly determined and reported by Chardon (**4**) as *X. polymorpha* (P.) Grev. I find no ascospores and his determination was evidently based on the conidial stage which is not *X. polymorpha* but resembles tab. 6, fig. 1 of Theissen's Xylariaceae austro-brasiliensis—II.

On living roots of *Coffea arabica* L.

ANTIOQUIA: Cafetal Los Micos, near Titiribi, No. *35*, May 13, 1926.

*154. XYLARIA RICKII Theiss. Ann. Myc. **6**: 342. 1908.

On dead wood.

EL VALLE: Forest at Hacienda Bitaco at Cordillera Occidental, No. *469*, June 11, 1929.

*155. XYLARIA SCOPIFORMIS Mont. Ann. Sci. Nat. **13**: 349. 1840.

According to Miller, this specimen agrees with Porto Rico No. *949*, collected by C. E. Chardon and determined by C. G. Lloyd. Theissen, in Xylariae austro-brasiliensis I, P. 9, makes this species a form under X. ***hypoxylon*** (L.) Grev.

On dead wood.

EL VALLE: Bamboo forest near San Pedro, No. *406*, June 4, 1929.

FUNGI IMPERFECTI

(CARLOS E. CHARDON and RAFAEL A. TORO)

ORDER I.—SPHAEROPSIDALES

Family 1. SHAERIOIDACEAE

*156. ACTINONEMA ROSAE (Lib.) Fries, Suma Veg. Scand. **1849**. 424.

Asteroma Rosae Lib., Mem. Linn. Soc. Paris **5**: 405. 1827.

On *Rosa* sp. (cult.)

The perfect stage *Diplocarpon Rosae* (S.) Wolf., described from North America but it has not been found outside the Continental area.

EL VALLE: Colegio N. S. de los Andes, above Cali, No. *454*, June 9, 1929.

*157. CINCINNOBELLA PARODIELLICOLA P. Henn., Hedwigia **43**: 386. 1904.

On *Parodiella paraguayensis* Speg. on *Meibomia purpurea* (Mill.) Vail.

ANTIOQUIA: Experiment Station Grounds, Medellín, No. *282* (R. A. Toro) Oct. 15, 1927.

*158. **Coniothyrium Panici** Sydow sp. nov.

Stromata hypophylla, plus minus aequaliter dispersa, sine maculis typicis, primitus decolorations minutas flavidas efficientia, demum in folio emortuo pallide et sordide ochracee colorate sifa, angusta, usque 1 mm vel ultra longa, 100–150 u lata, striiformia, axe vel dense seriatium disposita, parallelo currentia, intraepidermalia, sub-indo autem cum basi paullo profundius innata, parenchymatice contexta, 1-vel saepius pluriloculigere; loculi depresso-globosi, saepe sat irregularis, 50–80 u diam., ommio clausi, in maturitate ed verticem irregulariter disrumpentes; conidia oblongo-ovata vel ellipsoidea, utrinque non vel lenissime attenuata, obtusa, continua, diu hyalina, tandem mellea, saepe minute 1–2 guttulata, 5–7. u large, 2.5–3.5 u lata, in cellulis parietis brevissima conoidee vel papilliformiter prominulis orta.

On *Panicum maximum* Jacq.

EL VALLE: Dry trickets near San Pedro, N. of Buga. No. *417*, June 4, 1929 (type).

Linochora polyadelpha Sydow sp. nov.

Maculae haud typicae, irreguariter et laxe sparsce, subinde confluentes, in utraque folii pagina visibiles, sordide rufobrunneae, in hypophyllo pallidiores, 4–8 mm diam., pycnidia semper epiphylla, aequaliter et dense dispersa, in mesophylle profundo immersa, globulosa vel globosa-ovata, saepe irregularia, ostiolo plano atypice praedita, 180–250 u diam., membrana pycnidii 10–15 u crassa, concentrice fibrosa, vix vel indistincte celulosa sub-hyalina vel dilutissima flavida, ad' verticem atro-brunnea et clypeum minutum 20–35 u crassum formens; conidia copiosissima, filiformia, utrinque non ve santum une fine lenissime, attenuata, plerumque faleta, uncinata vel in forman signi S curvata, rare recta, continua, hyalina, 12–23 u longa, 1–1.5 u lata; coniodiophor'a subulata-bacillaria, sursum valde attenuata, simplicia, ad basim saep fasciculatim conjuncta, 12–25 u longa, ad basim 2–3 u lata.

On large undetermined tree, probably a *Coccoloba.*

PANAMÁ: Finca La Isleta, along road E. of Panamá City, No. *176,* Apr. 28, 1929. (type).

*159. PHOMA CARYOPHILLI Cooke, Grevillea **13**: 94. 1884.

On *Dianthus caryophillus* L.

ANTIOQUIA: Grainzales, No. *275 a* (R. A. Toro), Sept. 3, 1927.

*160. PHOMOPSIS VEXANS (Sacc. & Syd.) Harter, Jour. Agr. Res. **2**: 338. 1914.

Phoma vexans Sacc. & Syd. Syll. Fung. **14**: 889. 1899.

On *Solanum melongena* L.

This fungus was causing considerable damage to eggplants in the gardens around Cali. It was also observed although not collected, attacking eggpant seedlings in a Chinese garden near Colón, Panamá.

EL VALLE: Garden at San Fernando, just outside of Cali, No. *295,* May 18, 1929.

*161. PHYLLOSTICTA AURANTIICOLA (B. & C.) Sacc. Syll. Fung. **3**: **13**. 1884.

Sphaeropsis aurantiicola B. & C., Journ. Linn. Soc. **10**: 352. 1868.

Our specimen agrees with this species more than any other known on *Citrus.* The spores measure 4–8 x 1.3–26 u.

On *Citrus aurantifolia* (Christm.) Swingle.

EL VALLE: La Selva, near Tuluá, No. *524,* June 6, 1929. (det. J. A. B. Nolla).

162. SEPTORIA ALBO-MACULANS Sydow, Ann. Myc. **2**: 171. 1904.

On *Eupatorium* sp.

ANTIOQUIA: Medellín, No. *307* (R. A. Toro), June 10, 1928.

163. SEPTORIA LACTUCAE Peck. Atti Soc. Culteg. Italiana **2**: 35. 1879.
On *Lactuca sativa* L.

EL VALLE: Gardens outside of Cali, No. *405*, June 2, 1929. (det. C. Chupp).

164. SEPTORIA LYCOPERSICI Speg., Anal. Soc. Ci. Argent. **12**: 115. 1881.
On *Lycopersicum esculentum* L.

EL VALLE: Finca Rincon along Pance River, S. of Cali, No. *253*, May 14, 1929; Garden at Hotel Posso, Cartago, No. *379*, May 30, 1929.

*165. SEPTORIA PRINGRAE Speg., Anal. Soc. Cient. Argentina **13**: 17. 1882.
On *Baccharis floribunda* H. B. K.

ANTIOQUIA: Boquerón, No. *297* (R. A. Toro), Nov. 5, 1927.

*166. SEPTORIA TOVARENSIS Sydow, Ann. Mycol. **23**: 189. 1930.
The purple violet zones limiting the spots, as described for the species are not evident in our material and the spores measure 21–56 x 0.6–0. 8u.
On *Plantago hirtella* H. B. K.

EL VALLE: College N. S. de los Andes, above Cali, No. *459*, June 10, 1929.
CUNDINAMARCA: Ravines between Cerros Monserrate and Guadalupe, above Bogotá, No. *606*, June 25, 1929.

Family 2. LEPTOSTROMATACEAE

*167. LEPRIEURINA WINTERIANA Arnaud, Theses Fac. Sci. Paris **1598**:210. 1918.
On *Annona muricata* L.

EL VALLE: La Selva near Tuluá, No. *526*, June 6, 1929.

Family 3. EXCIPULACEAE

*168. EPHELIS MEXICANA Fries; Berk & Curt., Journ. Linn. Soc. **10**: 353. 1868.
On *Chaetochloa geniculata* (Lam) Millsp.

EL VALLE: Experiment Station grounds, near Palmira, No. *260*, May 15, 1929; Hacienda El Hatico, between Cerrito and Palmira. No. *348*, May 23, 1929. (det. F. J. Seaver).

ORDER II.—MELANCONIALES

Family 1—MELANCONIACEAE

169. COLLETOTRICHUM GLOEOSPORIOIDES (Penz.) Sacc., Syll. Fung. **3**: 735. 1884.

Vermicularia gloeosporioides Penzig, Michelia **2**: 450. 1882.

On *Mangifera indica* L.

EL VALLE: Finca Piedra Grande, S. of Cali, No. *241*, May 14, 1929.

ANTIOQUIA: Fredonia, No. 235, (R. A. Toro) April 20, 1927.

On *Citrus sinensis* Osbeck.

EL VALLE: Gardens at Palmira, No. *334*, May 21, 1929.

*170. **Pestalozzia Cavendishiae** Chardon & Toro sp. nov.

Fungus hypophyllous, elevated, mostly gregarious and hyphomyceteous; pustules at first sub-epidermal, later errumpent, freed, blackening the matrix, not tearing the epidermis, forming a pycnidium-like structure, raising 55–60 u above leaf-surface, 68–100 u wide; spores 5-celled, erect, fusoid, slightly curved, often constricted at septa, 20.3–23.8 u long, lower median cell olivaceous, the upper clear umber, colored portion 15.2–17.1 x 4–6 u; basal hyaline cell, conic, apical cells hyaline, conic-cylindric, bearing a crest of usually 3 widely curved setae, 10.4–12 u long; pedicel short, tapering to an acute point.

The color of the median cells of this species are very variable, showing characteristics of all three spore-groups of the genus, as arranged by Doyer (Meded. Phytopath. Lab. "Willie Comm. Schelt. **9**: 1925).

The species resembles *P. gracilis* Kleb, in color of spores.

On *Cavendishia pubescens* (H. B. K.) Britton.

ANTIOQUIA: Granizales, No. *274* (R. A. Toro) Sept. 11, 1927 (type).

ORDER III.—HYPHOMYCETALES

Family 1—MUCEDINACEAE

*171. OPHIOCLADIUM HORDEI Cavara, Zeitschr. Pzlanzenkr., **3**: 26. 1893.

On rotten leaf-sprouts of *Holcus sorghum sudanensis* Hitchc.

Heretofore only known from the type locality on leaves of *Hordeum vulgare*. In microscopical characters this fungus agrees with Cavara's diagnosis.

CUNDINAMARCA: La Picota Experimental Farm, South of Bogotá, No. *617* (in part), June 30, 1929.

*172. RAMULARIA AREOLA Atkinson, Bot. Gaz. **15**: 168. 1890.
On *Gossypium* sp.
EL VALLE: Hacienda El Hatico, between Cerrito and Palmira, No. *344.* May 23, 1929. (det. R. Ciferri).

*173. RAMULARIA OCCIDENTALIS Ellis & Kellerman.
On *Rumex obtusifolia* L.
CUNDINAMARCA: Ferrocarril de Girardot, near tunnel between Cipacón and Facatativa, No. *578,* June 21, 1929.

*174. VERTICILLIUM OCHRO-RUBRUM Desm., Ann. Sc. Nat. **22**: **71**.
On lesions produced by *Monilia* on *Theobroma Cacao* L.
TOLIMA: Campo Alegre (R. A. Toro No. *564*) March 10, 1930. (Collected by Vittorio Sacco.)

Family 2—DEMATIACEAE

175. ALTERNARIA SOLANI (Ellis & Martin) Jones & Grout, Journ Agric. Vict. **2**: 464. 1904.
Macrosporium Solani Ellis & Martin, Am. Nat. **16**: 1003. 1882.
On *Solanum tuberosum* L.
EL VALLE: Experiment Station grounds, near Palmira, No. *231,* May 11, 1929.
On *Capsicum annum* L.
ANTIOQUIA: Medellín, No. *337* (R. A. Toro) Sept. 10, 1928.

*176. CERCOSPORELLA CANA Sacc., Nuov. Gior. Bot. Ital. **8**: 188. 1876.
Dr. Chupp says about this species: "Three species of *Cercospora* have been described on *Erigeron: C. cana* Sacc., *C. griseëlla* Peck and *C. ferruginea* Fckl. The last named has brown, procumbent conidiophores, and therefore does not fit this specimen. *C. griseëlla* apparently is a synonym of *C. cana Sacc.,* although Peck does not state whether *C. griseëlla* conidiophores have color or not.—Saccardo says that the hyaline conidiophores of *C. cana,* relates it closely with *Ramularia,* but that the spores are *Cercospora* shaped.—This would make it a *Cercosporella.* The specimen certainly is a *Cercosporella* with hyaline, fasciculate (5–10 in cluster) very prominently geniculate conidiophores. As many as 10 scars on one coniodiophore where conidia have been borne 4-6 x 85–125 u. No septa observed. Conidia cylindrical on one end slightly attenuated. Both ends rounded, hyaline, granular contents, with small guttulae, 1–3 or more septate, 5–7 x 50–85 u. Mostly straight some curved

or slightly undulate. The description given of *C. cana* and *C. griseëlla* fit this specimen very well."

On *Erigeron spathulatus* Vahl.

ANTIOQUIA: Medellín, No. *102*, May 26, 1926.

*177. FUMAGO VAGANS Pers. Myc. Eu. **1**: 9. 1822.

On *Triticum aestivum* L.

CUNDINAMARCA: Sibaté, collected by Jorge Díaz *no number*, Sept. 2, 1929.

On *Dactylis glomerata* L.

CUNDINAMARCA: Chapinero, No. *540*, (R. A. Toro) Nov. 10, 1929.

178. HELMINTHOSPORIUM ORYZAE Breda de Haan, Bull. Inst. Bot. Buitenz. **6**: **11**. 1900.

On *Oryza sativa* L.

EL VALLE: Finca San Joaquín, S. of Cali, No. *233*, May 14, 1929.

CUNDINAMARCA: Girardot, No. *551*, (R. A. Toro), Feb. 10, 1929.

*179. HELMINTHOSPORIUM RAVENELII Curtis; Berk. Grevillea **3**: 102. 1874.

On *Sporobolus indicus* (L.) R. Br.

EL VALLE: Exp. Sta. grounds, Palmira, No. *259*, May 15, 1929. (det. H. H. Whetzel).

On *Sporololus Berteroanus* (Trin.) H. & C.

ANTIOQUIA: Medellín, No. *290* (R. A. Toro), Nov. 10, 1927.

On *Sporobolus* sp.

CUNDINAMARCA: Chapinero, No. 537 (R. A. Toro) Nov. 10, 1929.

*180. MACROSPORIUM PARASITICUM Thümen, Myc. Univ. 667. 1877.

On *Allium Cepa* L.

EL VALLE: Garden at La Cumbre, Cordillera Occidental, No. *517* June 7, 1929. (det. C. Chupp).

181. MACROSPORIUM PORRI Ellis, Grevillea **8**: 12. 1879.

On *Allium Cepa* L.

EL VALLE: Finca Rincón, along Pance R., S. Cali, No. *252*, May 14, 1929. (det. C. Chupp).

ANTIOQUIA: Medellín, No. *329* (R. A. Toro), July 28, 1928.

*182. **Napicladium Caricae** Chardon & Ciferri sp. nov.

Spots amphigenous, mostly circular, solitary, pale yellow at the center, brown on the periphery, indistinctly zonate, 3–12 mm. in diameter; conidiophores few in number, fasciculate, poorly developed, flexible, sub-erect, brownish, 2–4, generally 3–4, septate constricted at the apical septa, slightly so at the basal, ends rounded, 160–200 u long, 28–32 u wide; conidia acrogenous, light brown, solitary, 2-4 septate.

On leaves of *Carica* sp.

EL VALLE: Palmira—Pradera road, No. *341*, May 23, 1929. (type)

*183. ? POLYTHRINCIUM TRIFOLI Kunze & Schmidt. Myk. Hefte **1**: 3. 1817.

On *Trifolium repens*.

CUNDINAMARCA: Along road beyond Salto de Tequendama, No. *674* July 7, 1929. (det. C. Chupp).

CERCOSPORAE

CHARLES CHUPP *

*184. **Cercospora Ambrosiae** Chupp sp. nov. ad. interim.**

Spots irregular in shapo, frequently at the tip of the leaf, 2–10 mm. in diameter, medium to dark brown, sometimes not distinct below, difficult to differentiate from Septoria spots on the same foliage. Conidiophores amphigenous, in numerous fascicles, many of which arise from prominent dark spherical stromae, rarely less than 15 conidiophores in a fascicle. Conidiophores straight to slightly tortuous, fairly uniform in diameter, a few slightly geniculate, septation not very evident, 0–3, olivaceous in color, 4–5 x 30–80 u mostly 4 x 40–60 u. Conidia cylindrical to distictly obclavate, straight to curved, rounded at each end, with an evident papilla of attachment at the base of some, 1–5 septate, strong constriction at some of the septa, distinctly olivaceous in color, very variable in size, but characterized by being very wide as compared with the average Cercospora spore, 6–10 x 20–95 u.

This differs from *C. racemosa* in not having any procumbent, branched conidiophores, and having wide, colored conidia instead of the narrow ones which the original description of *C. racemosa* gives. The type material and also other material collected on *Teucrum canadense* really has olivaceous, wide conidia, but shows procumbent, branched conidiophores. Davis, 1924, gives notes on *C. racemosa* on *Prenanthes alba*, where he describes conidiophores in dense fascicles arising from a prominent stroma, and being unbranched, sparingly septate. But he states that the conidiophores are fuligenous and the conidia hyaline. This does not agree with the present specimen.

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* Contribution of the Department of Plant Pathology, Cornell University.

** Dr. Chupp, a modest but a very thorough investigator, has been reluctant in accepting the responsibility for the publication of his new species of *Cercospora* described herein, but we have ventured to publish them as new species "ad interim", thus giving him and other investigators an opportunity to verify them.—*The Authors.*

C. arcti-ambrosiae has been described on *Ambrosia*, but type material shows the conidiophores to be long, rather crooked, septation very evident, small branches common, and the spores very narrow and hyaline. Neither is it like *C. brunnea* nor *C. ferruginea* or other species on closely related Compositae.

On *Ambrosia peruviana* Willd.

Cundinamarca: Near tunnel between Cipacón and Facatativá, on the Girardot railroad, No. *580*, June 21, 1929 (type).

*185. Cercospora Apii Fr., Hedwigia **3**: 10. 1864.

On *Apium graveolens* L. var. *dulce* D. C.

El Valle: Garden at San Fernando, Cali, No. *296*, May 18, 1929.

*186. Cercospora atricinita H. & W., Mycol. **3**: 14. 1911.

On *Crassina elegans* (Jaq.) Kuntze.

Antioquia: Parque Independencia, Medellín, No. *251* (R. A. Toro) Sept. 3, 1927.

*187. Cercospora beticola Sacc., Nuov. Giorn. Bot. Ital. **8**: 189. 1876.

On *Beta vulgaris*, var. *cicla*.

El Valle: Garden at San Fernando, Cali, No. *305*, May 18, 1929.

On *Beta vulgaris* L.

El Valle: Hacienda Riopaila, S. of Zarzal, No. *400*, May 31, 1929.

*188. Cercospora Bloxami B. & Br., Ann. Mag. Nat. Hist. V, 9: 183. 1882.

It is difficult to decide what name to use. The following Cercosporae have been reported on Brassica: *brassica-campestris*, *albomaculans*, *brassicicola* (sometimes wrongly spelled crassicicola) *bloxami*, and *cruciferarum*. The oldest is *Bloxami* but Berkerley's description is so meager that it would be impossible to determine whether it is Cercospora. If we accept Young's (1916) amendment of this species, it has priority. After examining a large number of specimens of all the species named, and also reading the original description, it is so apparent that there are such slight differences that they can be classed as one excepting *albomaculans* which is a Cercosporella.

If cross-inoculations were made it probably could be proved that all the above names are synonyms of *C. armoraciae* on horse radish, for there is as much variation in this species as collected from a number of states, as there is between it and the other named species.

On *Brassica juncea* L.

El Valle: Along streets at La Cumbre, Cordillera Occidental, No. *515,* June 12, 1929.

*189. Cercospora Byrsoniamatis Maub., Bull. Soc. Myc. Fr. **36**: 40. 1920.

Since *Bunchosia* and *Byrsoniama* are so closely related and this specimen fits very closely the description given for *C. Byrsoniamatis* on *Byrsonima,* the same species is listed here on *Bunchosia.*

On *Bunchosia cornifolia* HBK.

El Valle: Along Cauca River, near Cali, No. *432,* June 8, 1929.

*190. Cercospora canescens E. & M., Amer. Nat. **16**: 1003. 1882.

Ten species of Cercospora have been reported on *Phaseolus.* Probably there are only two distinct species or possibly three. It will take some time to work out the synonymy. This seems to be *C. canescens,* as it fits the description very closely.

On *Phaseolus* sp.

El Valle: Near San Pedro, N. of Buga, No. *420,* June 4, 1929.

*191. Cercospora Cassiae P. Henn., Bull. herb. Boiss. **1**: 121. 1823.

Among the 15 species and varieties reported on Cassia, none of the descriptions fit exactly. I am listing it under *C. cassiae* P. Henn as the description most nearly fits it and because of the width of its spores. I have not seen a type specimen of *C. cassiae.* I have not seen Cercospora spores as wide as this, so that possibly it may be another genus. Characteristics of:

C. Cassiae	*This specimen*
Spots round, brown	the same
Spots amphigenous	‘‘ ‘‘
Fascicles hypophyllous	‘‘ ‘‘
Fascicles dense	‘‘ ‘‘
Fascicles dark brown	medium brown
Prominent stroma	same
Conidiophores not branched	‘‘
Conidiophores rarely septate	‘‘
Conidiophores brown	olivaceous brown
Spores long clavate	spores reverse napiform
Spores occasionally curved	spores straight
Spores yellowish olivaceous	spores yellowish olivaceous
Spores with large guttulae	spores the same
Spores 3–pluriseptate	spores 0–3 septate
Spores 8–12 x 21–50	spores 12–18 x 40–60

On *Cassia leptocarpa* Benth.

El Valle: Candelaria, No. *331,* May 21, 1929.

192. CERCOSPORA COFFEICOLA B. & C., Grevillea **9**: 98. 1881.
On *Coffea arabica* L.
EL VALLE: Hacienda Bitaco, Cordillera Occidental, No. *483*, June 11, 1929.

193. CERCOSPORA CAPSICI Heald & Wolf., Mycologia **3**: 15. 1911.
On *Capsicum frutescens* L.
EL VALLE: Garden at San Fernando, Cali, No. *299*, May 18, 1929.
On *Capsisum baccatum* L.
ANTIOQUIA: Fredonia, No. *232* (R. A. Toro) July 31, 1927.

*194. CERCOSPORA CEAREA Petch, Ann. Roy. Bot. Gard. Peradeniya **3**: 9. 1906.

The larger tan spots (few in number) are typically *Cercospora henningsii* Allesch. with the smooth, straight, brown almost not septate conidiophores, and very evident septate conidia. The fascicles are amphigenous. The small angular white centered spots have the fruiting bodies on the lower side of the leaf. The conidiophores are long, reaching 150 u are tortuous and geniculate very plainly multiseptate and more nearly olivaceous brown or smoky than pure brown as is *C. henningsii.* The conidia are very faintly or not at all septate. This does not fit in with *C. manihotis*, or any species described on this host. It more nearly fits the description of *C. cearae*, therefore, temporarily it is put under this species.

On *Manihot Manihot* (L) Cock.
PANAMÁ: Along road, 8 mi. E. of Panamá City, No. *181*, Apr. 28, 1929.
EL VALLE: Finca Piedra Grande, S. of Cali, No. *245*, May 14, 1929.

*195. **Cercospora Coriariae** Chupp. sp. nov. ad. interim.

Spots amphigenous, tobacco-brown, circular, definite, some bordered by a narrow darker margin, larger ones sometimes slightly zonate, mostly 1–3 on a leaflet, but occasionally as many as ten, on lower surface of leaf not so definite as above, 0.5–2.5 mm. in idameter. Fascicles arising from larger globose, brown or almost black, stromae, which to the unaided eye, have much the appearance of pycnidia. These are mostly epiphyllous, but some may be hypophyllous. The conidiophores arises from the stromae in rather dense fascicles, and are characterized by their narrowness (as compared with those of most other Cercospora species). They are more or less erect, rarely straight, but undulate to tortuous, not definitely denticulate nor geniculate, but sometimes bent slightly near the tip, septa very rarely guttulae present in a few of the larger ones, color olivaceous brown, 2.5–4 x 10–70 u, mostly about 3 u wide. Conidia obclavate, almost straight to curved or bent abruptly near the middle, multiseptate, but septa difficult to distinguish, guttulae prominent, and extending sometimes almost to the tip of the spore, the base is characteristically truncate, and the narrowed tip rounded, color olivaceous, almost light green, 4–5 x 50–100 u.

On *Coriaria thymifolia* H. & B.

CUNDINAMARCA: Slopes of Salto to Tequendama, No. *655*, June 6, 1929. (type).

*196. CERCOSPORA ERECHTITIS Atk., Jour. Elisha Mitchell Soc. **8**. 1892.

On *Erechtitis valerianaefolia* (Wolf) DC.

EL VALLE: Hacienda Riopaila, S. of Zarzal, No. 389, May 31, 1929.

*197. CERCOSPORA ERYTHROGENA Atk. Jour. Elisha Mitchell Soc. **8**: 1892.

Only 3 *Cercosporae* have been described on the Melastomaceae: *C. melastomatis* Pat.—1893, *C. miconiae* Frag. et Cif. 1927 and *C. erythrogena* Atk. 1892. The three have about the same description, all of which fit this specimen. All have branched conidiophores for instance, and almost hyaline very narrow spores. Atkinson's specimens look much like this although possibly not such long conidoiphores or spores. I had no specimens of *C. melastomatis* of *C. miconiae* to compare. The spots of No. *651*, do not look the same as those of *217*, but it is referred to the same species.

On *Aciotes indecora* (Boryl.) Triana.

EL VALLE: Near Buenaventura, No. *217*, May 8, 1929.

On *Miconia* sp.

CUNDINAMARCA: Slopes of Salto de Tequendama, No. *651*, July 6, 1929.

*198. CERCOSPORA ERYTHRINAE E. & E., Jour., Mycol. **3**: 18. 1887.

Both *C. erythrinae* and *C. erythrinicola* Tharp have been described on Erythrina. The *C. erythrinae* spots are very minute as compared with those of the other species. The conidiophores are supposed to be epiphyllous and those of the others hypophyllous. The conidiophores are supposed to be 30–50 and those of the other 40–75 u. These specimens have the type of spots described for *C. erythrinicola*, but the large stromae, the short conidiophores and the yellowish hyaline conidia described for *C. erythrinae*. The fruiting may be on both sides of the spots. Therefore I am inclined to believe that the two species may be the same, although I have not seen type material of *C. erythinicola*.

On *Erythrina* sp.

EL VALLE: Banks of Cauca River, near Cali, No. *318,* May 21, 1929.

On *Erythrina glauca* Wild.

EL VALLE: Banks of Cauca River, near Cali, No. *319,* May 21, 1929.

*199. CERCOSPORA FASEOLINA Speg., Anal. Soc. Ci. Argent. **12**: 1881.

Ten species of Cercospora are described on Phaseolus. The only one that comes near fitting this specimen is *C. faseolina* described by Spegazzini in Argentine on *P. ovatus.* It may later be found that the two are not the same. I have no specimens to make comparisons. These conidiospore's are so pale olivaceous that they might almost be taken for a Cercosporella.

On *Phaseolus vulgaris* L.

EL VALLE: Hacienda Bitaco, Cordillera Occidental, No. *475,* June 10, 1929.

*200. CERCOSPORA FUSIMACULANS Atk., Jour. Elisha Mitchell Soc. **8**: 1892.

Aside from slight differences in spore measurements and other minor variations, which do not seem to play much part in distinguishing one Cercospora from another, the Colombian specimen, *Cercospora panici* Davis and *C. fusimaculans* Atk. all seem alike. Therefore I am naming this specimen *C. fusimaculans.* It is interesting also that some one has suggested *C. sorghi* E. & E., which commonly is present on *Sorphum* and *Zea Mays* as being found on a *Panicum. C. sorghi* differs very little in its description—except as to size—from the other named species. It therefore is possible that *C. fusimaculans* is a synonym of *C. sorghi,* but this could not be determined without making cross-inoculations.

On *Panicum maximum* Jacq.

EL VALLE: Palmira, No. *293,* May 16, 1929.

*201. CERCOSPORA GILBERTII Speg., Anal. Soc. Ci. Argent. **10**: 38. 1880.

This specimen is characterized by the very evident lines of zonation in the spots, and which are wavy or scalloped in such a way as to make a rather pretty design. The conidiophores arise in very dense clusters from a large compact stroma. These points are not mentioned in Spegazzini's original description of *C. gilbertii.*

On *Iresine celosia* L.

TOLIMA: Along Combeima River, near Ibague, No. *572,* June 20, 1929.

*202. **Cercospora Hemidiodiae** Toro sp. nov.

Irregular, indefinite, small, brown or brick-red blotches that may coalosce and cover a large part of the leaflet. The spots have no definite border. On the corresponding lower side of the leaf are brown or dark patches of the fungous fruiting bodies which sometimes attain almost a purple shade. No stroma or only a very slight one is developed. The conidiophores arise in fascicles of less than ten, are long, curved or bent, branched and frequently ending in a long hypha-like extension which is more narrow and lighter colored than the lower part of the conidiophore, septa rare, guttulae in wider parts, olivaceous, 2–5 x 40–125 u. Conidia are borne standing erect or hanging downward. They are straight or curved, long and slender, distinctly obclavate, being gradually attenuated to an almost sharp point, both ends rounded, multiseptate, no constrictions, faintly olivaceous, 3–5 x 50–115 u.

This seems quite distinct from other species of *Cercospora* on other Rubiaceae and is characterized by its peculiarly branched conidiophores.

On living leaves of *Hemidiodia ocimifolia* (Wild.) Schum. Explorations of Porto Rico, Chardon No. *1174* (type), Coamo, August 23, 1920.

TOLIMA: Along Combeima River near Ibague, No. *573,* June 20, 1929.

*203. CERCOSPORA HENNINGSII Allesch.; P. Henn. in Engl. Ostafr. Pflanz. **3**: 35. 1895.

On *Manihot Manihot* (L.) Cock.

SANTANDER: Puerto Wilches, along Magdalena River, No. *166,* June 18, 1926.

EL VALLE: Finca Piedra Grande, S. of Cali, No. *244,* May 14, 1929; La Herradura, Palmira, No. *369,* May 28, 1929.

*204. CERCOSPORA HYPTIDIS Speg., Bol. Acad. Nac. Ci. Cordoba **11**: 1889.

This may be a new species, among the 14 species listed on the Labiateae. I am naming this *C. hyptidis* Speg. since Spegazzini's description fits the specimen more nearly than do any of the other thirteen. The conidiophores are branched which is not mentioned for *C. hyptidis*. Furthermore the conidiophores are shorter and the conidia longer than the measurements given by Spegazzini. *C. trichostemmatis* P. Henn. has branched conidiophores, but has colored conidia and in other ways differs from the specimen.

On *Hyptis verticillata* Jacq.

EL VALLE: Along river at Buga, No. *429,* June 5, 1929.

*205. CERCOSPORA KÖPKEI Kruger, Ber. d. Vers. Zuk. Ost-Java. 1890.

Five species of *Cercospora* have been reported on sugar-cane, namely, *köpkei, longipes, Sacchari, vaginae* and *acerosum*. This has some characteristics of all of them. *C. sacchari* has been changed to a *Helminthosporium*. *C. longipes* as drawn by Butler has far too spindly, wavy conidiophores to fit the specimen. The spots do not fit the description of *C. vaginae*. The description for *C. acerosum* is hardly complete enough to be sure of its identity. Therefore, by process of elimination, the specimen is named *C. köpkei* Kruger, although some of the other species named might be the same.

On *Saccharum officinarum* L.

EL VALLE: Finca Las Cañas, S. of Jamundi, No. *267*, May 15, 1929.

206. CERCOSPORA LONGISSIMA (Trav.) Sacc. Syll. Fung. **18**: 607. 1906.

Cercospora longispora (Cug. in herb.) Traverso, Malpighia **17**: 217. 1903.

Cercospora Lactucae Stevenson, Journ. Dept. Agric. Porto Rico. **1**: 105. 1917.

Cercospora Lactucae Welles, Phytopath. **13**: 289. 1923.

On *Lactuca sativa* L.

ANTIOQUIA: Medellín, No. *280* (R. A. Toro) Nov. 8, 1927.

*207. CERCOSPORA MALI Ell & Everh.

On *Pyrus Malus* L. (seedling).

EL VALLE: Finca Santa Bárbara, Palmira. No. *285*, May 16, 1929.

*208. CERCOSPORA MANGIFERAE Koorders, Philippine Jour. Sci. **8**: 507. 1913.

Sydow described this species as having fuscous spores. The spores are almost coal black, being darker in color than any other Cercospora spores I have ever seen. They seem mostly 5–septate. They are plainly obclavate, and therefore do not resemble a typical *Helminthosporium*.

On *Mangifera indica* L.

EL VALLE: La Herradura, Palmira, No. *370*, May 28, 1929.

*209. CERCOSPORA MEGALOPOTAMICA Speg., Anal. Soc. Ci. Argent. **12**: 1881.

Apparently this is *Cercospora megalopotamica* Speg, although I do not have authentic specimens with which to compare it. Occasional conidiophores are slightly branched which is not mentioned by Spegazzini.

On *Bidens pilosus* L.

El Valle: Finca Las Cañas, S. of Jamundi, No. *272*, May 15, 1929.

*210. Cercospora melastomatis Pat., Bull. Soc. Mycol. Fr. **9**: 160. 1893.

Three species of *Cercospora* have been reported on the Melastomataceae. *C. melastomatis*, *C. Miconiae* and *C. erythrogena.* The specimen does not agree with the descriptions for the last two. It does fit *C. melastomatis* more closely. The differences are that the specimen has more narrow conidiophores 3.5–4.5 instead of 6–7 u. Conidia are plainly olivaceous instead of light brown, and the conidiophores seem never to branch, while those of *C. melastomatis* are supposed to branch occasionally.

On *Miconia theazans* (Bonpl.) Cogn.

Cundinamarca: Near tunnel between Cipacón and Facatativá, on the Girardot railroad, No. *579*, June 21, 1929.

*211. Cercospora Melochiae P. Henn., Hedwigia **43**: 395. 1904.

On *Melochia lupulina* Sw.

El Valle: La Selva, near Tuluá, No. *327*, July 6, 1929.

212. Cercospora Nicotianae E. & E., Proc. Acad. Sci. Phila. **1893**: 170. 1893.

Three species of *Cercospora* have been described on *Nicotiana tabacum*—namely, *Nicotianae, Raciborskii,* and *solanicola.* Their three descriptions read much alike. Probably all are synonyms of each other. Raciborskii says the one named after him is *C. Nicotianae*, although Saccardo and Sydow dispute his statement. This material is like *C. nicotianae* excepting that the conidiophores sometimes attain 600 u in length and the conidia 250 u. Length, however has little to do with classification in *Cercosporae.* According to the collectors' notes, this is a very common spot of tobacco in Colombia.

On *Nicotiana tabacum* L.

El Valle: Candelaria, No. *330,* May 21, 1929.

Cercospora nymphaeaceae C. & E., Grevillea **6**: 89. 1878.

Both *C. nymphaeaceae* C. & E. and *C. exotica* E. & E. have been described on this host. Both the descriptions and the specimens show that the latter is a synonym having been described later.

On *Nymphaea* sp.

Panama: Plant Introduction Garden at Summit, Canal Zone, No. *191*, Apr. 29, 1929.

*213. Cercospora paulensis P. Henn., Hedwigia **48**: 18. 1909.

If we accept Maublanc and Rangel's amended description, this fits very well. In the end it may turn out to be the same as *C. simulata* (*C. chamaecrista*), excepting that in this and in the specimen which Rangel sent me, the fruit bodies do not form an effuse layer, but are in definite spots.

On *Cassia occidentalis* L.

El Valle: Railroad bridge near Cartago, No. *380*, May 30, 1929.

*214. Cercospora pipericola Sacc. & Syd., Mo. Bot. Gard. Ann. Rpt. **9**: 119. 1898.

Three species of *Cercospora* have been named on Piper: *C. pipericola* 1898, *C. portoricensis* 1901 and *C. piperis* Pat. 1895. The second is effuse on the lower side of the leaf, causing olivaceous, continuous patches. *C. pipericola* is similar only that the patches are limited and circular, while in *C. piperis*, there are definite dead areas in the leaf. The fruiting bodies of the three are similar so that all of them may be the same. This has not been proved. Therefore the name *C. pipericola*, (synonym *C. piperis* E. et E.) is used, for this is the species that has been described on *Piper hispidum*.

On *Piper hispidum* HBK.

Tolima: El Boqueron, W. of Ibagué, along road to Armenis, No. *700*, July 13, 1929.

215. Cercospora portoricensis Earle, Muhlenbergia **1**: 15. 1901.

On *Piper aduncum* L.

Antioquia: Medellín, No. *17*, Apr. 21, 1926.

On *Pothomorphe peltata* (L.) Miq.

Panama: Near Frijoles R. R. Station, Canal Zone, No. *199*, Apr. 29, 1929.

*216. Cercospora profusa Sydow., Ann. Mycol. **7**: 175. 1909.

On *Acalypha* sp.

El Valle: Experiment Station grounds, Palmira, No. *232*, May 11, 1929.

*217. Cercospora pteridis Siem., Arch. Biol. Towarz. Warsz. **114**: 57. 1923.

This fits Siemaszko's description very well, excepting that he states both the conidiophores and conidia have few septa. This specimen shows close septation.

On *Pteris* sp.

CALDAS: Along Quindio River, near Armenia, No. *722,* July 15, 1929.

*218. CERCOSPORA RICINELLA Sacc. & Berl. Atti Ist. Ven. VI, **3**: 11. 1885.

On *Ricinus communis* L.

EL VALLE: Pradera–Palmira Road, No. *340,* May 25, 1929.

219. CERCOSPORA RIGOSPORA Atk.. Jour. Elisha Mitchell Soc. **3**: 65. 1891.

On *Solanum nigrum* L.

ANTIOQUIA: Bolombolo, along Cauca River, No. *117,* May 27, 1926. Angelopolis, No. *331* (R. A. Toro) July 27, 1927.

EL VALLE: Banks of Cauca River, near Cali, No. 316, May 21, 1929; Hacienda Bitaco, Cordillera Occidental, No. *472,* June 10, 1929.

*220 CERCOSPORA ROSAECOLA Pass., Myc. Univ. 333; Bot. Jahresb. **1875**: 276.

On *Rosa* sp. (cultv.)

Among the shorter conidiophores which arise in fascicles from prominent stromae as is true of *C. rosaecola* are scattered, elongated conidiophores, seemingly borne singly and without stromae. These long conidiophores agree well with the description of *C. rosaecola* var. *undosa* Davis.

EL VALLE: Finca Piedra Grande, S. of Cali, No. *239,* May 14, 1929; Finca Santa Bárbara, Palmira, No. *284,* May 16, 1929.

*221. **Cercospora sensitivae** (Speg.) comb. nov.

Cercosporina sensitivae Speg., An. Museo Nac. Buenos Aires **20**: 427. 1910.

Spegazzini has divided *Cercospora* into the colored spored and hyaline-spored. The latter he names *Cercosporina* and he had named this *C. sensitivae* but with the very dilute coloring in many spores this division seems more confusing than helpful, and *Cercosporina* is not being retained.

On *Mimosa pudica* L.

EL VALLE: Buga la Grande, No. *536,* June 14, 1929.

*222. CERCOSPORA SIMULATA E. & E., Jour. Myc. **1**: 64. 1885.

Resemble somewhat immature perithecia. In No. *250,* even if little or no *Cercospora* can be found it must be the same as No. *314.*

Both Nos. *250* and *314* look in many ways like *Cercospora simulata*, and yet is not the same in all points. The conidiophores of this specimen do not seem to be in such strict fascicles, and some appear to be procumbent. The spores too, are a little more irregular in shape and longer. The spot looks like simulata, the color and septation of the conidiophores and conidia also meet the description. It does not look like any of the other 14 species and varieties reported on Cassia. No. *259* fits the description of the original, excepting that the conidiophores are shorter and conidia longer than the measurements recorded. Also instead of being brown, both the conidiophores and conidia are more nearly olivaceous. Excepting in the length of conidiophores, this specimen is much like No. *314*.

On *Cassia grandis* L.

EL VALLE: Finca Rincon, along Pance River, S. of Cali, No. *250* May 14, 1929; along banks of Cauca River near Cali, No. *314*, May 21, 1929.

On *Cassia hirsuta* L.

EL VALLE: Finca Rincon, along Pance River, S. of Cali, No. *259*, May 14, 1929; Finca Las Cañas, S. of Jamundi; No. *269*, May 15, 1929.

*223. CERCOSPORA SORGHI E. & E., Jour. Mycol. **3**: 15. 1887.

This fits very well *C. Sorphi* E. & E. It also fits very well—with one exception—the description of *C. zeae-maydis* Tehon and Daniels. They emphasize that conidiophores of their specimen had only scars and were not geniculate. Could this character have been brought about by extremely slow growth or just one period suitable for growing spores? The conidia of *C. sorghi* and *C. fusimaculans* are given as hyaline, but apparently both specimens on corn and *Panicum* have faintly olivaceous spores. The spores on the corn were very plainly septate, and nearly all the spores had three septa regardless of size. Occasionally there was one with four or more septa.

On *Sorghum*.

PANAMA: Along road Mi. E. of Panama City, No. *182*, Apr. 28, 1929.
EL VALLE: Finca Santa Bárbara, Pamira, No. *286*, May 16, 1929.

*224. CERCOSPORA SPHAEROIDEA Speg., Anal. Soc. Ci. Argent. **16**: 169. 1883.

I have not a specimen of *C. sphaeroidea* Speg. for comparison, but this fits very closely his description—more closely than does *C. Bauhiniae* which has been described on the genus *Bauhinia*. Of the

18 species and varieties reported on the Caesalpinacea, none of the others seem to be similar to this.

On Caesalpiniaceae.

EL VALLE: El Hatico, between Cerrito and Palmira, No. *355*, May 23, 1929.

CERCOSPORA STEVENSII Young, Mycologia **8**: 45. 1916.

Although the type material of *Cercospora Stevensii* does not have this peculiar spot depressed on top and bulging on the bottom, and its conidiophores are somewhat larger than of this specimen, the two are undoubtedly the same. Both have very dark, sinuous, conidiophores that arise from a dark stroma, and the conidia are of similar shapes and color. Young says the spores are hyaline, but type material shows they are pale olivaceous yellow. The peculiar twisting of the conidiophores which Young mentions, may refer to the sinuous condition near the ends of the conidiophores.

On *Andira inermis* HBK.

PANAMA: Finca La Isleta, along road 5 m. E. of Panama City, No. *175*, Apr. 28, 1929.

CERCOSPORA STIZOLOBII Syd., Ann. Mycol. **11**: 270. 1913.

Sydow has described both *Cercospora stizolobii* and C. *mucunae* on *Stizolobium*. Type material of *C. Mucunae*, shows that all American and Porto Rican collections given this name are *Cercospora Stizolobii.*

On *Stizolobium Deeringianum.*

PANAMA: Along road 8 Mi. E. of Panama City, No. *182*, Apr. 28, 1929.

*225. CERCOSPORA TRICHOPHILA Stevens, Trans. Il. Acad. Sci. **10**: 212, 1917.

On *Solanum torvum* Sw.

SANTANDER: Baranca Bermeja, along Magdalena River, No. *138*, June 17, 1926.

EL VALLE: Near Buenaventura, No. *221*, May 8, 1929; Finca "Rincon", along Pance River, S. of Cali, No. *256*, May 14, 1929; Experiment Station grounds, Palmira, No. *290*, May 16, 1929.

CUNDINAMARCA: Along road beyond Salto de Tequendama, No. *679*, June 7, 1929.

Family 3—STILBACEAE

Chardonia Ciferri gen. nov.

Hyalostilbeae didymosporae; synnema woody, dense, light colored, erect, glabrous; capitule compact, glabrous or nearly so, spheric to sub-spheric; conidiophores continuous or indistictly septate, hyaline, producing conidia by scission; conidia elliptic or cylindric, isolated or in short chains, arising at the apex of the conidiophores, hyaline, smooth, 1-septate; saprogenous, lignicolus. Type: *Chardonia rosea* Cif.

*226. **Chardonia rosea** Ciferri, sp. nov.

Erect fascicle of hyphae (Synnema) single, scattered over the surface of the substratum, not branched, pink to pale, 2–4 mm., usually 3 mm. in length; stalk (stipes) cylindric or nearly so, slightly enlarged at the base, 1–1.5 mm. diam., 2–3 mm. long, glabrous, woody, composed of hyaline, continuous or septate, erect, parallel, densely aggregated, 3–4 u. thick hyphae; head (capitule) spheric to sub-spheric, glabrous or nearly so, 1–2 mm., generally 1–1.5 mm. in diam., composed of tangled, hyaline, scarcely septate, conidigerous hyphae (conidiophores) conidiophores with round to sub-truncate apex, 1.5–2.5 u. thick, irregularly branched, mixed with sterile hyphae; conidia (arthrospores) produced by scission, isolated or in chains of 2–3 elements, 1–septate, narrowed at the septa, equilateral or slightly unsymmetric, cylindric, cylindric-apiculate or irregular in shape, 7–7 u. long, 3–4 u. thick; saprogenous, lignicolus.

On dead stems of *Guadua latifolia* Kunth.

EL VALLE: Banks of Cauca River, near Cali, No. *306*, May 21, 1929. (type).

Dedicated to the senior collector Carlos E. Chardon, well-known mycologist and specialist on tropical fungi. Among the few genera included in the Hyalostilbaceae didymosporae, this genus is related to *Didymostilbe*, but differs in the shape of the conidia.

227. STILBELLA FLAVIDA (Cooke) P. Henn., Bol. Mus. Goeldi **4**: 413. 1904.

Stilbum flavidum Cooke, Grevillea **9**: 11. 1880.

A very common parasite of coffee causing the well known American coffee disease. Its perfect stage, the basidiomycete *Omphalia flavida* (Cooke) Rang. et Maubl. was found in one instance by the senior writer on partially decayed coffee leaves.

On *Coffea arabica* L. *Synedrella notiflora* (L.) Gaertn., *Bidens* sp., *Oplismenus* sp., *Plantago* sp., and other weeds.

EL VALLE: Hacienda Bitaco, Cordillera Occidental, Nos. *493*, *494*, *495*, *496*, *497* and *498*, June 11, 1929.

TOLIMA: Along Combeima River near Ibagué, No. *576*, June 20, 1929.
On *Saracha Jaltomata* L.
ANTIOQUIA: Fredonia, No. *342*, (R. A. Toro) July 10, 1928.

Family 4—TUBERCULARIACEAE

AEGERITTA WEBBERI Fawcett, Mycologia **2**: 167. 1910.
On black fly on native lemon.
PANAMÁ: Garden at Ingenio Santa Rosa, No. *209*, May 5, 1929.

228. ASPERISPORIUM CARICAE (Speg.) Maub. Bull. Soc. Myc.
Cercospora Caricae Speg. Anal. Soc. Ci. Argentina **22**: 205. 1886.
Pucciniopsis Caricae Earle, Bull. N. Y. Bot. Gard. **2**: 340. 1902.
Pucciniopsis Caricae (Speg.) Seaver. Porto Rico. **8**: 104. 1926.
On *Carica Papaya* L.
ANTIOQUIA: Below Fredonia, near Cauca river, No. *238* (R. A. Toro), July 27, 1927.

USTILAGINALES

H. S. JACKSON *

The following fourteen species of smuts include all the Colombian collections of which we have any knowledge. Unless otherwise stated, the collections here reported for the first time were made by Commissioner Carlos E. Chardon during May–July of 1929. A few were collected in association with Sr. J. A. B. Nolla.

All the previous collections which have come to our knowledge were made by Dr. Eugene Mayor, of Neuchatel, Switzerland, who collected extensively in Colombia in 1910, and one by Dr. Chardon in 1926. These included 5 species. Three of these were included in the paper by H. and P. Sydow "Contribution a l' étude des champignons parasites de Colombie" published in Mem. Soc. Neuch. Sci. Nat. **5**: 422–411, 1914. The fourth species (No. 241 of this list) was reported later by Sydow (Ann. Myc. **13**: 37, 1915). The fifth one, or the corn smut, was collected and reported by Chardon in a previous paper (**4**) from Antioquia in 1926, where it seemed to be of common occurrence.

According to the testimony of Commissioner Chardon, who spent some time collecting in the Sabana de Bogotá at an altitude of 8,650 feet, the cereal smuts reported in this paper were causing considerable damage to wheat, oats and barley at La Picota Experimental

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* Contribution from the Department of Botany, University of Toronto, Canada.

Farm and are probably wide-spread in the temperate sections of Colombia.

Several of the collections made by Dr. Chardon were identified by Professor H. H. Whetzel of Cornell University before they were sent to me, and No. *341* was seen by Dr. G. P. Clinton of the Connecticut Agricultural Experimental Station. All the identifications have, however, been verified by the present author who assumes all responsibility for their correctness.

Family 1.—USTILAGINACEAE

*229. USTILAGO AVENAE (Pers.) Jensen, Charb. céréales 4. 1889.

Ustilago segetum Avenae Pers. Tent. Disp. Fung. 57. 1797.

This, one of the two common smuts attacking cultivated oats is practically co-extensive throughout the world with the cultivation of that crop. The other species *U. levis* (K. & S.) Magn. has not been reported for South America so far as we have been able to determine.

On *Avena sativa* L.

CUNDINAMARCA: La Picota Experimental Farm, S. of Bogotá, No. *626*, June 30, 1929.

*230. USTILAGO HORDEI (Pers.) Kell. & Swingle, Ann. Rept. Kansas Agr. Exp. Sta. **2**: 268. 1890.

Uredo segetum Hordei Pers. Tent. Disp. Fung. 57. 1797.

This so-called "covered smut" of barley is known nearly whereever that crop is in cultivation. It may be distinguished from the loose smut of barley by the smooth spores and by the fact that the sori are in the individual spikelets and the entire inflorescence is usually not consumed in the formation of the spores.

On *Hordeum vulgare* L.

CUNDINAMARCA: La Picota Experimental Farm, S. of Bogotá, No. *624*, June 30, 1929.

*231. USTILAGO NUDA (Jensen) Kell. & Swingle, Ann. Rept. Kans. Agr. Exp. Sta. **2**: 277. 1890.

Ustilago Hordei nuda Jensen, Charb. Céréales 4. 1899.

The "loose smut" of barley affects the host in the same manner as the loose smut of wheat, (*U. Tritici* (Pers.) Rostr.). It may be distinguished from *U. Hordei* by the roughened spore walls and by the fact that the inflorescence, except the rachis, is usually completely consumed in the formation of spores.

On *Hordeum vulgare* L.

CUNDINAMARCA: La Picota Experimental Farm, S. of Bogotá, No. *625*, June 30, 1929.

*232. USTILAGO STRIAEFORMIS Westened, Viesal, Hedwigia **15**: 1. 1876.

Uredo striaeformis Westend. Bull. Acad. Roy. Belg. **18**²: 406. 1851.

This common smut has a wide distribution in North America and in Europe and occurs in a wide range of grasses. The host listed above, however, is an uncommon one for this species.

On *Notholcus lanatus* (L) Nash.

CUNDINAMARCA: Wet meadows above Salto de Tequendama, Nos. *669, 670,* July 6, 1929.

*233. USTILAGO TRITICI (Pers.) Rostr. Overs. K. Danske Vid. Selsk. Forh. **1899**: 15. 1890.

Uredo segetum Tritici Pers. Tent. Disp. Fung. 57. 1797.

This is the "loose smut" of wheat. It corresponds in morphology and effect on the host and in life history to the loose smut of barley. It is found practically wherever wheat is grown.

On *Triticum vulgare* L.

CUNDINAMARCA: La Picota Experimental Farm, S. of Bogotá, No. *623,* June 30, 1929.

234. USTILAGO ZEAE (Beckm.) Unger.

On *Zea Mays* L.

ANTIOQUIA: Cafetal "Amalia" near Venecia, No. *108*, May 28, 1926.

235. SPHACELOTHECA HYDROPIPERIS (Schum.) DeBary. Verg. Morph. Biol. Pilze 187. 1884.

Uredo Hydropiperis Schum. Enum. Pl. Saell. **2**: 234. 1803.

Ustilago Hydropiperis Schrot., Beitr. Biol. Pfl. **2**: 355. 1877.

A common smut, found throughout the world on species of *Polygonum*. It has been previously collected on the same host at two localities in Cundinamarca, Colombia, by Eug. Mayor (Nos. *104, 104 a.*)

On *Polygonum acre* H. B. K.

CUNDINAMARCA: Along road beyond Salto de Tequendama, No. *681,* July 7, 1929.

*236. **Sphacelotheca cordobensis** (Speg.) comb. nov.

Ustilago cordobensis Speg. Anal. Soc. Ci. Argent. **12**: 64. 1881.

Ustilago Panici-leucophaei Brefeld, Unters. Gesammt. Myk. **12**: 114. 1895.

Ustilago insularis P. Henn. Hedwigia **35**: 51. 1896.

Sphacelotheca Panici-leucophaei Clinton, N. Am. Flora **7**: 28. 1906.

Ustilago cacheutensis Speg. Anal. Mus. Nac. Buenos Aires **19**: 293. 1909.

The type collection of this species was collected near Córdoba, Argentina, by Dr. Hieronymus. The host was recorded in error as *Panicum Jaboncillum* (see Speg. Anal. Mus. Nac. Buenos Aires **19**: 288, 1909). Spegazzini (Rev. Argent. de Bot. **1**: 153. 1925) includes his two species as synonymous with *U. Panici-leucophaei* Bref., which was originally collected at Río de Janeiro, Brazil. The host is always *Valota* (*Panicum*) *insularis*. The species has apparently a wide distribution in South America and is known throughout Central America and the West Indies. A collection on *Panicum saccharatum* made in Arizona, U.S.A., is assigned to this species by Clinton (l.c.).

On *Valota insularis* (L.) Chase.

El Valle: Experiment Station Grounds, Palmira, No. *261*, May 15, 1929.

*237. Sphacelotheca Paspali-notati (P. Henn.) Clinton, Jour. Myc. **8**: 140. 1902.

Ustilago Paspali-notati P. Henn. in Herb.

This rare species was originally described from Mexico on *Paspalum notatum*.

On *Paspalum plicatulum* Michx.

El Valle: Near Cartago, *537*, June 14, 1929.

Family 2.—Tilletiaceae

238. Cintractia axicola (Berk.) Cornu, Ann. Sci. Nat. VI, **15**: 279. 1883.

Ustilago axicola Berk. Ann. Mag. Nat. Hist. II, **9**: 200. 1852.

This species appears to be common on various species of *Fimbrystylis* throughout Central America and the West Indies and in the South Eastern United States. The sori occur at the base of the peduncles or pedicels. It has been previously reported from Colombia by Sydow based on collections made by Mayor in Antioquia in three different localities (Nos. *259*, *259 a*, *259 b*).

On *Fimbrystylis diphylla* (Retz.) Vahl.

Panamá: Near well at Government Farm at Aguadulce, No. *210*, May 5, 1929.

El Valle: Near Buenaventura, No. *226*, May 8, 1929.

*239. CINTRACTIA LEUCODERMA (Berk.) P. Henn. Hedwigia **34**: 335. 1895.

Ustilago leucoderma Berk. Ann. Mag. Nat. Hist. II, **9**: 200. 1852.

This very striking species produces elongated sori surrounding the peduncles and pedicels, often also involving the rachis. It has a wide distribution from Florida throughout the West Indies and Central America and has been reported from a number of localities in South America.

On *Rynchospora corymbosa* (L.) Britton.

EL VALLE: Finca Las Cañas, S. of Jamundi, No. *264*, May 5, 1929; Marshes near R. R. station at Riopaila, No. *396*, May 31, 1929.

*240. TILLETIA ULEI Schrot. & P. Henn. Hedwigia **35**: 218. 1896.

This species was described from material collected on *Paspalum scrobiculatum* in Santa Catharina, Brazil, by E. Ule. The type has not been seen and the identification is tentative. The collection corresponds quite closely to *Tilletia rugispora* Ellis. Our collection, however, has somewhat smaller spores than in the specimen of that species distributed in Ell. & Ev. N. Am. Fungi No. *2704* and the sterile cells are larger and with thinner walls. It is entirely possible that when a range of collections can be studied the two species will be found to be synonymous.

On *Paspalum paniculatum* L.

EL VALLE: Hacienda Bitaco, Cordillera Occidental, No. *481*, June 10, 1929.

241. ENTYLOMA GALINSOGAE Sydow, Ann. Myc. **13**: 37. 1915.

The type of this rare species was collected on the same host in Colombia by Mayor. The exact type locality cannot be determined from the original description. Sydow (l.c.) says "pluribus locis (Angelopolis, Medellín, El Poblado, Cisneros) in Andibus Colombiae, 8. 1910, leg. Eug. Mayor."

On *Galinsoga caracasana* (DC) Sch. Bip.

EL VALLE: Hacienda La Foresta, Pradera, No. *336*, May 21, 1929.

UROCYSTIS ANEMONES (Pers.) Wint. Rah. Krypt. Fl. **1**: 123. 1881.

Uredo Anemones Pers. Tent. Disp. Fung. 56. 1797.

This species was not collected by Dr. Chardon. The above listed collections were made by Eug. Mayor, and reported by Sydow. The smut has a wide distribution on a large number of species and genera of Ranunculaceae.

On *Ranunculus pilosus* H.B.K.

ANTIOQUIA: Chemin de Neira a Manizales, October 2, 1910, No. *208*; Cafetal "La Camelia" near Angelopolis, August 25, 1910, No. *208 a*.

UREDINALES

F. D. KERN and H. H. WHETZEL *

Apparently the first report of a species of the Uredinales from Colombia was that of *Trichobasis Oxalidis* (*Puccinia Oxalidis* (Lev.) Dietel & Ellis) by Léveillé in 1863 (Prodomus Florae Novo-Granatensis Crytogamie, Ann. Sci. Nat. 4. ser. XX, p. 299). The next report is that of Earle in 1899 (Bull. Torrey Club **26**: 632) in which he reports six species collected by Baker and determined by Dietel. This constitutes a first report from Colombia of the following species and the only report thus far for the four last:

Coleosporium Elephantopodis (Schw.) Thüm.

Puccinia claviformis Lagerh. (*Puccinia solanita* (Schw.) Arth.)

Puccinia appendiculata Wint. (*Prospodium appendiculatum* (Wint.) Arth.)

Puccinia Bombacis Diet.

Uromyces Manihotis P. Henn.

Uromyces Cissampelis Diet.

Acording to Mayor (Mem. Soc. Neuch. Sci. Nat. **5**: 442) the Princess Therese de Baviere (Beih. Bot. Centralb. B. **13**: 8) in 1903 reported two species from Colombia, *Uromyces Hedysari-paniculati* (Schw.) Farl. and *Uredo Theresiae* Neger. Sydow in 1902 and 1910 (Monog. Ured. vol. 1 & 2) is authority for two additional species from Colombia, *Uromyces euphorbiicola* (Berk. & Curt.) Tranz. (*Uromyces pröeminens* (DC.) Pass.) and *Puccinia levis* (Sacc. & Bizz.) P. Magn.

Altogether at the time of Mayor's excellent and comprehensive paper in 1914 (Contribution a l'étude des Uredinées de Colombie. Mem. Soc. Neuch. Sci. Nat. **5**: 442–599) at least eleven species had been reported rather than six as Mayor stated. Of the 158 species included in Mayor's paper, seven are not Colombian, that is they are only from Jamaica, Haití, or Martinique, and two are most certainly not rusts (*Aecidium amagense* Mayor and *Aecidium medellinense* Mayor which Sydow refers to *Woroninella*, Monog. Ured. **4**: 339, 1923) and several others are considered by us synonymous with others in the list. According to our disposition Mayor's paper includes 142 valid species of which 137 are there first reported, of which number 82 were described by him as new species.

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* **Contribution from the Department of Botany, Pennsylvania State College and the Department of Plant Pathology, Cornell University.**

In 1915 Lindau (Orchis **9**: 177) reported *Uredo Scabies* Cooke from Colombia on *Vanilla planifolia.* In 1927 Kern and Chardon (Mycologia **19**: 268–276) reported ten additional species from Colombia, based on collections made by Chardon in April-June, 1926.

In 1927 Mr. R. A. Toro took a position in Colombia, first in connection with the Escuela de Agricultura at Medellín and later with the government at Bogotá. Since that time he has made many collections (upwards of eighty) and on the basis of these there are here reported seventeen additional species of which four are described as new species.

In 1929 Commissioner Carlos E. Chardon and Sr. J. A. B. Nolla were in Colombia as a part of an agricultural survey group from Porto Rico and took occasion to collect fungi securing more than 180 collections of rusts. Our studies of these reveal 28 species not heretofore reported from Colombia of which four are described as new. This makes a total of 204 species from the country.

Undoubtedly this falls far short of representing the complete rust-flora of this area. We do not have an equivalent area with which to make comparisons, California with only about one-third the area of Colombia has 237 known rusts. New England with about one-seventh the number of square miles of Colombia has 205 species. Pennsylvania and Cuba are about equal in size and approximate only one-tenth the area of Colombia and have 159 and 140 known species respectively. The island of Porto Rico, considerably less than one per cent of the area of Colombia has 181 known species. These figures are given because of some interest that may attach to them and not because of any significance they have. We do not know what the factors are that determine the presence or absence of these parasitic plants or their distribution. The number of host plants, the topography of the region, and the intensiveness with which collecting has been done, all enter into our present knowledge of rust populations. It is believed that the larger information which we are gradually building up regarding the rust-flora of various areas will come to be the foundation of a fuller understanding of the problems of distribution and ecology.

It is with pleasure that the authors acknowledge the assistance of several colleagues in their own institutions in these studies and also their indebtedness to numerous phanerogamic botanists for host determinations.

Family 1—MELAMPSORACEAE

UREDINOPSIS Magn. Atti. Congr. Bot. Genova 167. 1893.

UREDINOPSIS MACROSPERMA (Cooke) Magn. Hedwigia **43**: 122. 1904.

Uredinopsis Pteridis Diet. & Holw. Ber. Deuts. Bot. Ges. **13**: 331. 1895.

On *Pteridium aquilinum* (L.) Kuhn.

ANTIOQUIA: *Mayor.*

Known also from Canada, United States, Bermuda, Hawaii, Europe, Asia, and Africa.

UREDINOPSIS MAYORIANA Diet. Mem. Soc. Neuch. Sci. Nat. **5**: 556. 1913.

On *Blechnum blechnoides* Lag.

ANTIOQUIA: *Mayor.*

MILESINA Magn. Ber. Deuts. Bot. Ges. **27**: 325. 1909.

MILESINA BLECHNI Syd. Ann. Myc. **8**: 491. 1910.

On *Blechnum occidentale* L.

ANTIOQUIA: *Mayor.*

CUNDINAMARCA: *Mayor.*

MILESINA COLUMBIENSIS Diet.; Mayor. Mem. Soc. Neuch. Sci. Nat. **5**: 559. 1913.

On *Nephrolepis pendula* Raddi.

ANTIOQUIA: *Mayor.*

MILESINA DENNSTAEDTIAE Mayor. Mem. Soc. Neuch. Sci. Nat. **5**: 558. 1913.

On *Dennstaedtia rubiginosa* (Kaulf.) Moore.

ANTIOQUIA: *Mayor.*

PHAKOPSORA Diet. Ber. Deuts. Bot. Ges. **13**: 334. 1895.

PHAKOPSORA (?) AESCHYNOMENSIS Arth. Bull. Torrey Club **44**: 509. 1917.

Uredo Aeschynomensis Arth. Bot. Gaz. **39**: 392. 1905.

On *Aeschynomene americana* L.

ANTIOQUIA: *Mayor.*

On *Aeschynomene sensitiva* Sw.

ANTIOQUIA: *Mayor.*

*242. **Phakopsora columbiana** Kern & Whetzel sp. nov.

Uredinia hypophyllous, scattered, roundish, 0.2–0.4 mm. across, sometimes partly covered by the overarching epidermis, usually pulverulent, pale yellow, urediniospores broadly ellipsoid or obovate-globoid, 23–27 x 26–31 u, the wall cinnamon brown, prominently echinulate, 2 u or more thick, the pores obscure.

Telia hypophyllous, more or less gregarious, 0.1–0.3 mm. across, indehiscent, 4–7 cells thick; teliospores oblong, 19–24 x 36–48 u, the wall smooth, nearly colorless, about 1.5 u thick.

On *Croton gossypifolius* Vahl.

TOLIMA: Outskirts of Ibagué, Nos *555, 552 b,* June 20, 1929. (type).

This species differs from *P. Crotonis*, *P. mexicana,* and *P. dominicana,* all of which occur on *Croton,* in having teliospore-walls which are nearly colorless. The others are brown or smoky. There are also other spore and sorus characters which assist in making it stand by itself. The teliospores are distinctly catenulate and the apical wall of the outer spores is not or only slightly thicker.

*243. PHAKOPSORA VITIS (Thüm.) Syd. Hedwigia **38**: 141. 1899.

? *Uredo caucensis* Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 587. 1913.

On *Vitis* sp.

EL VALLE: Hacienda Bitaco, Cordillera Occidental, No. *479*, June 10, 1929.

Known also from southeastern United States, the West Indies, and Japan.

CRONARTIUM Fries, Obs. Myc. **1**: 220. 1815.

244. CRONARTIUM PRAELONGUM Wint. Hedwigia **26**: 24. 1887.

Cionothrix praelonga Arth. N. Am. Fl. **7**: 124. 1907.

On *Eupatorium conyzoides* Vahl.

CUNDINAMARCA: *Mayor.*

On *Eupatorium inulifolium* H. B. K.

CUNDINAMARCA: *Mayor.*

On *Eupatorium merifolium* Miller.

MAGDALENA: Santa Marta, H. H. Smith No. *669*, Dec. 20, 1898.

On *Eupatorium odoratum* L.

CUNDINAMARCA: Slopes of Salto de Tequendama, No. *643 a,* July 6, 1929; along Funza River trail to Hacienda San Antonio, No. *686,* July 11, 1929.

On *Eupatorium pomaderrifolium* Benth.

CUNDINAMARCA: *Mayor.*

On *Eupatorium popayanense* Hieron.
ANTIOQUIA: Boqueron, (R. A. Toro) No. *296*, Jan. 5, 1928.

On *Eupatorium tacotanum* Klatt.
EL VALLE: Mountains above Cali, No. *440*, June 9, 1920.
ANTIOQUIA: *Mayor.*

On *Eupatorium tequendamense* Hieron.
CUNDINAMARCA: *Mayor.*

On *Eupatorium thyrsigerum* Hieron.
EL VALLE: *Mayor.*
CUNDINAMARCA: *Mayor.*

On *Eupatorium* sp.
SANTANDER: *Chardon.*
ANTIOQUIA: *Mayor.*

Also known in southern Mexico southward to Panama.

This is a microcyclic species having only pycnia and telia. The species is notable for the variability of both its macroscopic and microscopic characters. It is possible that there may be races more or less distinguished by structural characters. The telial columns sometimes are only a few mm. in length but on other hosts may be a cm. or more long. The columns also vary greatly in diameter, some being only 25–40 u whereas others are 110–130 u. The spores also vary from 11–14 x 25–35 u up to 20–26 x 36–52 u. The basidiospores are also extremely variably some measuring 6–9 x 8–14 u and others 12–16 x 16–20 u.

COLEOSPORIUM Lev. Ann. Sci. Nat. III. **8**: 373. 1847.

COLEOSPORIUM BOCCONIAE (Mayor) Sydow, Monog. Ured. **4**: 343. 1923.

Aecidium Bocconiae Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 560. 1913.

On *Bocconia frutescens* L.
ANTIOQUIA: *Mayor.*

Evidently considered not an aecidium but the uredinial stage of a Coleosporium.

245. COLEOSPORIUM DOMINGENSE (Berk.) Arth. Am. Jour. Bot. **5**: 329 1918.

Coleosporium Plumierae Pat. Bull. Soc. Myc. Fr. **18**: 178. 1902.
On *Plumiera alba* L.
EL VALLE: Finca Piedra Grande south of Cali, No. *249*, May 14, 1929.

On *Plumiera* sp.

ANTIOQUIA: *Chardon.*

Known also from the West Indies, Guatemala, and Panama.

246. COLEOSPORIUM ELEPHANTOPODIS (Schw.) Thüm. Myc. Univ. **953**: 1878.

On *Elephantopus mollis* H. B. K.

EL VALLE: Finca las Cañas south of Jamundi, No. *276*, May 15, 1929.

TOLIMA: Along Combeima River near Ibagué, No. *574*. (date?)

CALDAS: Along Quindio River near Armenia, No. *715*, July 14, 1929.

ANTIOQUIA: *Chardon.*

On *Elephantopus scaber* L.

ANTIOQUIA: *Mayor.*

CUNDINAMARCA: *Mayor.*

On *Elephantopus* sp. C. F. Baker *86*.

On *Pseudoelephantopus spicatus* (Juss.) Rohr.

EL VALLE: Cauca River near Cali, No. *315*. May 21, 1929; mts. above Cali, No. *446*, June 9, 1929.

Known also from southern United States, Central America and the West Indies.

247. COLEOSPORIUM EUPATORII Arth. Bull. Torrey Bot. Club **33**: 31. 1906.

On *Eupatorium macrophyllum* L.

CALDAS: Along Quindio River near Armenia, No. *719*, July 14, 1929.

ANTIOQUIA: *Mayor.*

Known also from Central America and the West Indies.

248. COLEOSPORIUM IPOMOEAE (Schw.) Burr. Bull. Ill. Lab. Nat. Hist. **2**: 217. 1885.

Coleosporium Fischeri Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 550. 1913.

On *Ipomoea* aff. *caloneura* Meiss.

ANTIOQUIA: *Mayor.*

On *Ipomoea* sp.

CALDAS: Ravines near Armenia, No. *541*, June 19, 1929.

ANTIOQUIA: *Mayor.*

On *Jacquemontia* sp.

ANTIOQUIA: Bello, (R. A. Toro) No. *288*, Nov. 4, 1927.

On *Quamoclit angulata* (Lam.) Bojer.

ANTIOQUIA: *Mayor.*
CUNDINAMARCA: *Mayor.*
On *Quamoclit coccinea* (L.) Moench.
EL VALLE: Hacienda El Hitaco between Cerrito and Palmira, No. *361*, May 23, 1929.

Known also in eastern United States, Mexico, Central America, and the West Indies.

Family 2—PUCCINIACEAE

CHRYSOCELIS Lagerh. & Diet. Mem. Soc. Neuch. Sci. Nat. **5**: 542. 1913.

CHRYSOCELIS LUPINI Lagerh. & Diet. Mem. Soc. Neuch. Sci. Nat. **5**: 542. 1913.
On *Lupinus* sp.
CUNDINAMARCA: *Mayor.*

Known also in Costa Rica.

CEROTELIUM Arth. Bull. Torrey Bot. Club. **33**: 30. 1906.

249. CEROTELIUM DESMIUM (B. & Br.) Arth. N. Am. Fl. **7**: 698. 1925.
Uredo Gossypii Lagerh. Jour. Myc. **7**: 48. 1891.
On *Gossypium barbadense* L.
ANTIOQUIA: Fredonia (R. A. Toro) No. *237*, July 31, 1927.
BOLIVAR: *Chardon.*
On *Gossypium hirsutum* L.
CUNDINAMARCA: Granja La Esperanza, No. *590*, June 23, 1929.
On *Gossypium peruvianum* Cav.
EL VALLE: Buenaventura, No. *222*, May 8, 1929.
ANTIOQUIA: *Chardon.*
On *Gossypium* cf. *religiosum* L.
ANTIOQUIA: *Mayor.*

Known also in Florida, the West Indies, India, Java, New Guinea, and the Philippines.

250. CEROTELIUM FICI (Cast.) Arth. Bull. Torrey Bot. Club **44**: 509. 1917.
On *Ficus Carica* L.
ANTIOQUIA: Titiribi (R. A. Toro) No. *278*, Nov. 8, 1927.
EL VALLE: Finca Piedra Grande, south of Cali, No. *247*, May 14, 1929.

CALDAS: Across river north of Cartago, No. *378*, May 30, 1929.
NARIÑO: Berruecos, (L. Pardo Navarro) No. *571*, March, 1930.
ANTIOQUIA: *Chardon.*

Known also in southern United States, central America, the West Indies and other tropical regions throughout the world.

TRANZSCHELIA Arth. Result. Sc. Congr. Bot. Vienne 340. 1906

251. TRANZSCHELIA PUNCTATA (Pers.) Arth. Result. Sci. Congr. Bot. Vienne 340. 1906.

Puccinia Pruni-spinosae Pers. Syn. Fung. 226. 1801.

On *Amygdalus persica* L.

EL VALLE: Mountains above Cali, No. *436*, June 9, 1929.
CUNDINAMARCA: *Mayor.*
ANTIOQUIA: *Chardon.*

Known also from North America, Europe, Africa, and Australia.

SPIRECHINA Arth. Jour. Myc. **13**: 30. 1907.

*252. **Spirechina columbiensis** Kern and Whetzel sp. nov.

Pycnia epiphyllous, few in crowded groups, prominent, becoming blackish with age; subcuticular, flattened hemispherical or mammaloid, 112–160 u broad by 80–130 u high, pycniospores numerous.

Uredinia at first (primary) epiphyllous, few surrounding the pycnia sori irregularly roundish, bullate, ruptured epidermis not well shown, soon rupturing, pulverulent, dirty white or yellowish; urediniospores subglobose or ellipsoid, 18–21 x 23–32 u, the echinulate, the pores obscure.

Telia hypophyllous, scattered, small, about 0.1 mm. across, soon naked, pulverulent, pale yellow or whitish; teliospores narrowly obovate or oblong, 15–19 x 42–58 u, usually germinating upon maturity, the wall nearly or quite colorless, thin, about 1 u, thicker above, up to 3–5 u, smooth; urediniospores often intermixed.

This new species differs from *S. Rubi-urticifolii* in having teliospores with walls thicker above; from *S. cundinamarcensis* and *S. quitensis* in the much smaller size of the teliospores; and from *S. variabilis* in the smooth walls of the teliospores as well as in other less conspicuous characters. The teliospore characters ally this species with *S. Lagerheimii* but the spores are larger being 42–58 u long as compared with 33–42 u. Other spore forms of *S. Lagerheimii* are un known and further comparisons cannot be made.

On *Rubus* sp.

ANTIOQUIA: Titiribi (R. A. Toro) No. *266*, Aug. 8, 1927. (type).

Spirechina cundinamarcensis (Mayor) comb. nov.

Uromyces cundinamarcensis Mayor, Mem. Soc. Neuch. Sci. Nat. 5: 452. 1913.

On *Rubus peruvianus* Fritsch.

CUNDINAMARCA: *Mayor.*

Spirechina Lagerheimii (P. Magn.) comb. nov.

Uromyces Laberheimii P. Magn. Ber. Deuts. Bot. Ges. **14**: 377. 1896.

On *Rubus glaucus* Benth.

TOLIMA: *Mayor.*

On *Rubus* sp.

ANTIOQUIA: *Mayor.*

253. SPIRECHINA LOESENERIANA (P. Henn.) Arth. Jour. Myc. **13**: 30. 1907.

Uromyces Loesenerianus Sydow, Monog. Ured. **2**: 202. 1910.

On *Rubus urticifolius* Poir.

ANTIOQUIA: Salgar (R. A. Toro) No. *323*, April 4, 1928.

ANTIOQUIA: *Mayor.*

Known also from Central America.

The spirally marked urediniospores differentiate this species from the other Colombian species of this genus.

Spirechina quitensis (Largerh.) comb. nov.

Uromyces quitensis Lagern. Bull. Myc. Soc. France **11**: 213. 1895.

On *Rubus* sp.

ANTIOQUIA: *Mayor.*

CUNDINAMARCA: *Mayor.*

254. **Spirechina Rubi-urticifolii** (Mayor) comb. nov.

Uromyces Rubi-urticifolii Mayor. Mem. Soc. Sci. Nat. **5**: 454. 1913.

On *Rubus urticifolius* Poir.

ANTIOQUIA: *Mayor.*

On *Rubus* sp.

ANTIOQUIA: Medellín, (R. A. Toro) No. *270.* Dec. 29, 1927.

ANTIOQUIA: *Mayor.*

255. **Spirechina variabilis** (Mayor) comb. nov.

Uromyces variabilis Mayor, Mem. Soc. Neuch Sci. Nat. **5**: 457. 1913.

On *Rubus* sp.

CUNDINAMARCA: Ravine between Cerro Monserrate and Guadalupe, No. *610*, June 25, 1929.
CUNDINAMARCA: *Mayor.*

The variable character of the teliospores in this species is striking. In some spores the walls are smooth over the apex, and not much thickened while in others the walls at the apex are thicker and lobed or with numerous rounded projections.

PHAGMIDIUM Link, Ges. Nat. Freunde Berlin Mag. **7**: 30. 1815.

256. PHRAGMIDIUM DISCIFLORUM (Tode) James, Contr. U. S. Nat. Herb. **3**: 276. 1895.

On *Rosa* sp. (cultivated)

CUNDINAMARCA: Chapinero (R. A. Toro) No. *413*, July 31, 1929. *Mayor.*

Known also from North America, Europe, western Asia, and Hawaii.

A widespread rust on cultivated roses, especially those having large and firm leaflets. Our specimen has only unrediospores present which is the case for the specimen reported by Mayor.

PROSPODIUM Arth. Jour. Myc. **13**: 31. 1907.

PROSPODIUM APPENDICULATUM (Wint.) Arth. Jour. Myc. **13**: 31. 1907.

Puccinia appendiculata Wint. Flora **67**: 262. 1884.

On Bignoniaceae.

MAGDALENA: C. F. Baker No. *93*.

Known also from central Mexico and the West Indies.

Reported by Earle (Bull Torrey Club **26**: 632. 1899). Dietel who studied these specimens says the appendages are poorly developed or wanting but that he does not doubt this determination.

Prospodium Von Gunteni (Mayor) comb. nov.

Puccinia Von Gunteni Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 490. 1913.

On *Lippia americana* L.

BOLIVAR: *Mayor.*

This species resembles *P. Lippiae* Speg. but has smaller urediniospores (20–24 u as compared with 23–27 u) and thinner walls (3–5 u as against 5–7 u), and the teliospore-pedicels have only one whorl of appendages as compared with three or four whorls.

DICHEIRINIA Arth. N. Am. Fl. **7**: 147. 1907.

257. DICHEIRINIA BINATA (Berk.) Arth. N. Am. Fl. **7**: 147. 1907.
Uredo Cabreriana Kern & Kellerm. Jour. Myc. **13**: 25. 1907.
On *Erythrina glauca* Willd.
ANTIOQUIA: Medellín (R. A. Toro) No. 181, March 19, 1927; *Chardon.*
EL VALLE: Banks of Cauca River near Cali No. *320*, May 21, 1929.

RAVENELIA Berk. Gard. Chron. **10**: 132. 1853.

*258. RAVENELIA INDIGOFERAE Tranz. Hedwigia **33**: 369. 1894.
On *Indigofera subulata* Vahl.
ANTIOQUIA: Medellín (R. A. Toro) No. *178*, March 11, 1927.
On *Indigofera suffruticosa* Mill.
EL VALLE: Banks of Cauca River, No. *313*, May 21, 1929.

Known also from Mexico, the West Indies, and Bermuda. This is the first report of this species from Colombia.

259. RAVENELIA INGAE (P. Henn.) Arth. N. Am. Fl. **7**: 12. 1907.
Uromyces porcensis Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 459. 1913.
On *Inga adenophylla* Pittier.
ANTIOQUIA: Medellín, (R. A. Toro) No. *190*, April 20, 1927.
On *Inga edulis* Mart.
ANTIOQUIA: *Chardon.*
On *Igna* cf. *Ingoides* (Rich.) Willd.
ANTIOQUIA: *Mayor.*
On *Inga* sp.
EL VALLE: Mountains above Cali, Nos. *437*, *448*, June 9, 1929; Hacienda Bitaco, Cordillera Occidental, No. *490*, June 11, 1929.
ANTIOQUIA: *Chardon.*

Known also from Eastern Mexico and the West Indies.

RAVENELIA MAINSIANA Arth. & Holw. Am. Jour. Bot. **5**: 426. 1918.
On *Mimosa alba* H. B. K.
ANTIOQUIA: *Chardon.*

RAVENELIA MIMOSAE-SENSITIVAE P. Henn. Hedwigia Beibl. **35**: 246. 1896.
On *Mimosa sensitiva* L.
ANTIOQUIA: *Mayor.*

*260. RAVENELIA PITHECOLOBII Arth. Bot. Gaz. **39**: 394. 1905.

On *Pithecolobium lanceolatum* Benth. (genus name also written *Pithecellobium*).

EL VALLE: Near Santa Ana between Cartago and the Cauca River, No. *374* May 29, 1929.

Known also from southern Florida, central Mexico, and Cuba.

The first report of this species from Colombia.

UROMYCES Unger, Exanth. Pff. 277. 1833.

UROMYCES AFFINIS Wint. Hedwigia **24**: 259. 1885.

Uredo hypoxidis P. Henn. Hedwigia **40**: 173. 1901.

On *Hypoxis decumbens* L.

ANTIOQUIA: *Mayor.*

UROMYCES ANTIOQUIENSIS Mayor, Mem. Soc. Neuch. Sci., Nat. **5**: 445. 1913.

On *Rhynchospora polyphylla* Vahl.

ANTIOQUIA: *Mayor.*

261. UROMYCES APPENDICULATUS (Pers.) Fries, Summa. Veg. Scand. 514. 1849.

On *Phaseolus lunatus* L.

CUNDINAMARCA: Slopes of Salto de Tequendama, No. *648*, July 6, 1929.

ANTIOQUIA: *Chardon.*

EL VALLE: Finca Las Cañas, south of Jamundi, No. *280 a*, May 25, 1929.

On *Phaseolus vulgaris* L.

ANTIOQUIA: Machado (R. A. Toro) No. *203*. May 20, 1927.

EL VALLE: Garden at San Fernando, No. *298*; La Paz, Andalucia, No. *350*, June 7, 1929.

On *Vigna luteola* (Jacq.) Benth.

ANTIOQUIA: *Mayor.*

*262. UROMYCES ASCLEPIADIS (Schw.) Barth. Handb. N. Am. Ured. 54. 1928.

On *Asclepias curassavica* L.

EL VALLE: Candelaria, No. *328*, May 21, 1929.

Known also in Canada, United States, Guatemala, and the West Indies.

This is the first report from Colombia.

263. UROMYCES BIDENTICOLA (P. Henn.) Arth. Mycologia **9**: 71. 1917.

On *Bidens pilosa* L.

CUNDINAMARCA: Granja La Esperanza, No. *586*, June 23, 1929.
ANTIOQUIA: *Chardon.*

On *Bidens squarrosus* H. B. K.

CUNDINAMARCA: Slopes of Salto de Tequendama, No. *645*, July 6, 1929; *Mayor.*

Known also from the West Indies and Martinique.

This is a macrocyclic species of which uredinia and telia are known. It is not to be confused with *U. Bidentis* Lagerh., a microcyclic species which is known on *Bidens pilosa*. Mayor (p. 470) reported this species from Colombia on *B. pilosa* and *B. squarrosus* but called it *U. Bidentis* in error. Reference to the host *B. bipinnatus* (Mycologia **19**: 271. 1927) as from Colombia is also an error as that specimen was from Jamaica and not from Colombia. The microcyclic species *U. Bidentis* is also reported from Colombia in this paper.

*264. UROMYCES BIDENTIS Lagerh. Bull. Soc. Myc. Fr. **11**: 213. 1895.

On *Bidens pilosa* L.

EL VALLE: Above Cali, No. *450*, June 9, 1895.

Known also from Martinique and the West Indies.

This is the first report of this microcyclic species from Colombia. See note under *Uromyces bidenticola.*

*265. UROMYCES CESTRI (Mont.) Lev. Ann. Sci. Nat. III. **8**: 371. 1847.

On *Cestrum parviflorum* Dun.

BOYACÁ: Duitama, (R. A. Toro) No. *406*, Feb. 20. 1929.

On *Cestrum* sp.

ANTIOQUIA: (R. A. Toro) No. *366*, Salgar, July 20, 1926.

Known also in the West Indies.

UROMYCES CISSAMPELIDIS Dietel; Earle. Bull. Torrey Club. **26**: 632 1899.

On *Cissampelos* sp.

MAGDALENA: Near Santa Marta, C. F. Baker No. *83*.

This has not since been reported from Colombia.

UROMYCES COLUMBIANUS Mayor, Mem. Soc. Neuch. Sci Nat. **5**: 467. 1913.

On *Melanthera aspera* (Jacq.) Steudel.

ANTIOQUIA: *Chardon.*
CALDAS: *Mayor.*

On *Melanthera aspera* (Jacq.) Steudel var. *canescens* (O. Kuntze) Thellung.
ANTIOQUIA: *Mayor.*

Known also in the West Indies, Central America, and Trinidad.

266. UROMYCES COMMELINAE (Speg.) Cooke, Trans. Roy Soc. Edinb. **31**: 342. 1888.

On *Tradescantia cumanensis* Kunth.
ANTIOQUIA: Angelopolis (R. A. Toro) No. *207*, July 27, 1927.

On *Tradescantia multiflora* L.
ANTIOQUIA: *Mayor.*

Known also from Southern Brazil, Argentina, southern United States, Porto Rico, Africa and Japan.

267. UROMYCES CRUCHETI Mayor, Mem. Soc. Neuch. Sci. Nat **5**: 464. 1913.

On *Borreria tenella* (H. B. K.) Cham. & Schlecht.
ANTIOQUIA: *Mayor.*

Un Rubiaceae undet.
ANTIOQUIA: Guarnes (R. A. Toro) No. *265*, Nov. 3, 1927

UROMYCES DOLICHOLI Arth. Bull. Torrey Club **33**: 27. 1906.

On *Rhynchosia* cf. *longeracemosa* Mart. & Gall.
ANTIOQUIA: *Mayor.*

*268. UROMYCES FABAE (Pers.) DeBary, Ann. Sci. Nat. IV. **20**: 80. 1865.

On *Vicia Faba* L.
ANTIOQUIA: Guarnes (R. A. Toro) No. *263*, Nov. 3, 1927.
Known also in the United States, Mexico, Europe, and Asia.
This is the first report from South America.

UROMYCES GURANIAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 466. 1913.

On *Gurania* sp.
ANTIOQUIA: *Mayor.*

UROMYCES HEDYSARI-PANICULATI (Schw.) Farl.; Ellis. N. Am. Fungi 246. 1879.

Uredo amagensis Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 584. 1913.

On *Desmodium mexicanum* Sweet.
TOLIMA: Qundió, Andes Centrales (coll. by Therese de Baviere).
On *Desmodium tortuosum* (Sw.) DC.
ANTIOQUIA: *Mayor.*

Known also in the United States, Mexico, Central America, and the West Indies.

Although Mayor maintained that his collections which he described as a new species, *Uredo amagensis,* were different from *Uromyces Hedysari-paniculati* we have nevertheless united them.

UROMYCES HYPERICI-FRONDOSI (Schw.) Arth. Bull. Minn. Acad. Sci. **22**: 15. 1883.
On *Hypericum* aff. *uliginoso* H. B. K.
ANTIOQUIA: *Mayor.*

UROMYCES IRESINES Lagerh. Syd. Monog. Ured. **2**: 227. 1910.
On *Iresine paniculata* (L.) Kuntze.
ANTIOQUIA: *Mayor.*
CUNDINAMARCA: *Mayor.*

269. UROMYCES LEPTODERMUS Syd.; Syd & Butler. Ann. Myc. **4**: 430. 1906.
On *Lasciacis ruscifolia* (H. B. K.) Hitchc.
ANTIOQUIA: Medellín (R. A. Toro) No. *179,* March 11, 1927.
On *Lasciacis sorghoidea* (Desv.) Hitchc. & Chase.
EL VALLE: Above Cali, No. *439,* June 9, 1929; near La Cumbre, Cordillera Occidental, No. *514,* June 12, 1929.
On *Panicum barbinode* Trin.
ANTIOQUIA: *Chardon.*
On *Panicum lanatum* Sw.
ANTIOQUIA: *Mayor.*

Known also from the West Indies and India.

It seems probable that the specimen on *Panicum lanatum* called *Uredo Henningsii* by Mayor (p. 578) belongs here. The characters of the uredospores which he gives would not admit it to *U. Henningsii* which is a synonym of *Puccinia substriata.*

UROMYCES MANIHOTIS P. Henn. Hedwigia **34**: 90. 1895.
On *Manihot* sp.
MAGDALENA: C. F. Baker *84.*

Dietel, who determined some rusts collected by Baker in Santa Marta, Colombia and reported by Earle (Bull. Torrey Club. **26**: 632.

1899), status under *Uromyces Manihotis* that "Hennings has only described the teleutospores but on specimens received from him I also find the uredospores which correspond exactly with this No. *84* (C. F. Baker)". The type locality of *U. Manihotis* is Brazil. In Saccardo Syll. Fung. *Uromyces manihoticola* P. Henn., also from Brazil, is considered a synonym.

In the Earle paper no host is given for this species. It is here assumed to be *Manihot* sp. This is the only report of this species from Colombia.

UROMYCES MAYORII Franz.; Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 463. 1913.

On *Euphorbia orbiculata* H. B. K.

CUNDINAMARCA: *Mayor.*

270. UROMYCES MEGALOSPERMUS Speg. Anal. Mus. Nac. Buenos Aires 218. 1899.

On *Tessaria integrifolia* Ruiz & Pav.

ANTIOQUIA: Fredonia (R. A. Toro) No. *242*, July 31, 1927; *Chardon.*
ANTIOQUIA: *Mayor.*

*271. UROMYCES NERVIPHILUS (Grongnot) Barth. Handb. N. Am. Ured. 69. 1928.

On *Trifolium repens* L.

CUNDINAMARCA: Zipaquira (R. A. Toro) No. *407*, March 20, 1929.
BOYACA: Duitama (R. A. Toro) No. *411*, Feb. 20, 1929.

Known also from Canada, the United States and France.

This species is very much like *Uromyces oblongus* Vize but differs in having the sori specially on the petioles and nerves and somewhat larger teliospores. Apparently the first report from South America.

*272. UROMYCES NEUROCARPI Diet. Hedwigia **34**: 292. 1895.

On *Martiusia rubiginosa* (Juss.) Britton.

ANTIOQUIA: Salgar, (R. A. Toro) No. *368*, July 20, 1928.

Known also from Mexico and the West Indies. Appears to be the first report from Colombia.

UROMYCES PHTHIRUSAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 448. 1913.

On *Phthirusa pyrifolia* (H. B. K.) Eichler.

ANTIOQUIA: *Mayor.*

Uromyces Polymniae (P. Henn.) Diet. & Holw. Bot. Gaz. **31**: 327. 1901.

On *Polymnia glabrata* DC.

Cundinamarca: *Mayor.*

273. **Uromyces prominens** (DC.) Pass., Rab. Fungi Eur. 1795. 1873.

Uromyces euphorbiicola Tranz. Ann. Myc. **8**: 8. 1910.

On *Chamaesyce brasiliense* (Lam.) Small.

Antioquia: Fredonia, (R. A. Toro) No. *240*, July 31, 1927.

On *Chamaesyce hirta* (L.) Millsp. (*Euphorbia pilulifera* L.)

El Valle: Finca Rincón, South of Cali, No. *254* date ?; between Cerrito and Palmira, No. *360*, May 23, 1929; near Rozo, northwest of Palmira, No. *397*, May 31, 1929.

Antioquia: *Chardon.*

Antioquia: *Mayor* (as *Euphorbia pilulifera* L.)

Mayor states that this species was reported in Sydow's Monograph (vol. **2**, p. 161, 1910) prior to the publication of his paper but does not give any information as to the date or collector. Sydow indicates that the Colombian specimen was collected by Karsten. Although many of Karten's specimens are at Kew this one could not be found there.

Uromyces Smilacis Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 448. 1913.

On *Smilax* sp.

Antioquia: *Mayor.*

*274. **Uromyces Solani** Diet. & Howl. Bot. Gaz. **24**: 24. 1897.

On *Solanum* sp.

Cundinamarca: Along road to Salto de Tequendama, No. *675*, July 6, 1929.

Heretofore known only from Central Mexico and Guatemala.

Our specimen has only uredinia.

*275. **Uromyces Urbanianus** P. Henn. Hedwigia **36**: 213. 1897.

On *Oryctanthus botryostachys* Eichl.

El Valle: Along Cauca River, No. *435*, June 8, 1929.

Known also from Salvador and Trinidad.

This species is evidently related to *Uromyces Phtirusae* but has larger teliospores which are verrucose with warts sometimes arranged in rows whereas *U. Phtirusae* is prominently striate with ridges.

PUCCINIA Link, in Willd. Sp. Pl. **62**: 67. 1825.

276. PUCCINIA ABREPTA Kern, Mycologia **11**: 140. 1919.
On *Cyperus* sp.
CALDAS: Ravines near Calarcá along Armenia-Ibagué road, No. *707*, July 13, 1929.
ANTIOQUIA: *Chardon.*
Otherwise known only from the type locality in Costa Rica.

PUCCINIA ANCIZARI Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 525. 1913.
On *Baccharis nitida* Pers.
ANTIOQUIA: *Mayor.*
CUNDINAMARCA: *Mayor.*
Known also from Guatemala.

277. PUCCINIA ANODAE Syd. Monog. Ured. **1**: 475. 1903.
On *Anoda cristata* (L.) Schlecht.
EL VALLE: Cali, E. P. Killip (phan. spec.) No. *6200*, June 1–2, 1922.
On *Anoda hastata* Cav.
ANTIOQUIA: *Mayor.*
Known also in southern Mexico and Central America.

278. PUCCINIA ARECHAVALETAE Speg. Anal. Soc. Ci. Argent **12**: 67. 1881.
On *Cardiospermum* sp.
TOLIMA: Front of Girardot, (R. A. Toro) No. *552*, Feb. 10, 1929.
On *Serjania* (?) *brevipes* Benth.
EL VALLE: Near Buga, No. *428*, June 5, 1929.
On *Serjania membranacea* Splitg.
EL VALLE: Thickets near San Pedro, north of Buga, No. *423*, June 4, 1929.
On *Serjania* sp.
ANTIOQUIA: *Mayor.*
On Sapindaceae sp.
CUNDINAMARCA: *Mayor.*
Known also in southern United States, Mexico, and the West Indies.

*279. PUCCINIA ATRA Diet. & Holw. Bot. Gaz. **24**: 29. 1897.
On *Paspalum prostratum* Scrib. & Merr.
CUNDINAMARCA: Salto de Tequendama, Nos. *663*, *665*, July 6, 1929.
Known also from Brazil and from Texas and New Mexico southward to Guatemala.

280. PUCCINIA BACCHARIS-RHEXIOIDES Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 517. 1913.

On *Baccharis rhexioides* H. B. K.

EL VALLE: Finca Las Cañas south of Jamundi, No. *273*, May 15, 1929.

CALDAS: Ravines near Armenia, No. *546*, June 19, 1929.

ANTIOQUIA: *Mayor.*

PUCCINIA BARRANQUILLAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 533. 1913.

On *Spilanthes urens* Jacq.

BOLIVAR: *Mayor.*

PUCCINIA BECKI Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 509. 1913.

On *Vernonia Cotoneaster* (Wild.) Less.

CUNDINAMARCA: *Mayor.*

Known also from Jamaica.

281. PUCCINIA BIMBERGI Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 478. 1913.

On *Heliopsis buphthalmoides* (Jacq.) Dunal.

ANTIOQUIA: La Camelia, Angelopolis (R. A. Toro) No. *289*, Jan. 22, 1928.

ANTIOQUIA: (Same locality as the preceding) *Mayor.*

PUCCINIA BOCCONIAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 478. 1913.

On *Bocconia frutescens* L.

ANTIOQUIA: *Mayor.*

PUCCINIA BOGOTENSIS Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 480. 1913.

On *Geranium multiceps* Turez.

CUNDINAMARCA: *Mayor.*

A microcyclic species with large teliospores (18–24 x 65–87 u).

PUCCINIA BOMBACIS Deitel; Earle, Bull. Torrey Club **26**: 632. 1899.

On *Bombax* sp.

MAGDALENA: Near Santa Marta, C. F. Baker *80*.

Known only from the type locality.

282. PUCCINIA CAEOMATIFORMIS Lagerh., Sydow Monog. **1**: 24. 1902.

On *Baccharis floribunda* H. B. K.

CUNDINAMARCA: Slopes of Salto de Tequendama No. *644*, July 6, 1929, ravines between Cerro Monserrate and Guadalupe above Bogotá, No. *599*, June 25, 1929.

On *Baccharis polyantha* H. B. K.

ANTIOQUIA: *Mayor.*

CUNDINAMARCA: *Mayor.*

This is a very interesting microcyclic species because of the exceptionally large spores which measure 25–42 x 70–135 u. There is probably no known Puccinia with larger teliospores. The spores germinate upon maturity and the sporidia are comparatively large being oval and measuring 18–21 u long. The pedicel is sometimes 28 u broad above and often as long as the spore. The original description does not mention pycnia but our specimens have them few in number, gregarious, on the spots opposite the telia. The pycnia are about 200 u broad by 250 u high.

PUCCINIA CAMELIAE (Mayor) Arth. Mycologia **7**: 227. 1915.

Uredo Cameliae Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 578. 1913.

On *Chaetochloa scandens* (Schrad.) Scribn. & Merr. (*Setaria scandens* Schrad.)

ANTIOQUIA: *Mayor.*

Known also from Brazil, Texas, and the West Indies.

*283. PUCCINIA CANALICULATA (Schw.) Lagerh. Tromsö Mus. Aarsh. **17**: 51. 1894.

On *Cyperus ferax* L. C. Rich.

EL VALLE: Near Buenaventura, No. *220*, May 8, 1929.

Known also in Bolivia, British Guiana, the United States, Mexico, Central America and the West Indies.

284. PUCCINIA CANNAE Wint.) P. Henn. Hedwigia **41**: 105. 1902.

On *Canna coccinea* Miller.

ANTIOQUIA: *Mayor.*

On *Canna* sp.

CALDAS: Along Quindio River near Armenia No. *712*, July 14, 1929.

A common rust in Central America and the West Indies.

PUCCINIA CAPSICI Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 501. 1913.

On *Capsicum* cf. *baccatum* L.

TOLIMA: *Mayor.*

285. PUCCINIA CENCHRI Diet. & Holw.; Holway, Bot. Gaz. **24**: 28. 1897.

On *Cenchrus echinatus* L.

EL VALLE: Along river at Buga, No. *430*, June 5, 1929.

ANTIOQUIA: *Mayor.*

BOLIVAR: *Chardon.*

On *Pennisetum bambusiforme* (Tourn.) Hemsl.

ANTIOQUIA: Granizales (R. A. Toro) No. *276*, Sept. 11, 1927.

Known also from Brazil, United States, Mexico, Central America, and the West Indies.

This is the first report from South America on a species of *Pennisetum.*

*286. PUCCINIA CHAETOCHLOAE Arth. Bull. Torrey Club **34**: 585. 1907.

On *Paspalum macrophyllum* H. B. K.

EL VALLE: Finca Santa Bárbara, Palmira, No. *287*, May 16, 1929.

Known also from Florida, and the West Indies.

*287. PUCCINIA CLEMATIDIS (DC.) Lagerh. Tromsö Mus. Aarsh. **17**: 54. 1895.

On *Bromus unioloides* H. B. K.

CUNDINAMARCA: Slopes of Salto de Tequendama, No. *647*, July 6, 1929.

On *Triticum aestivum* L.

EL VALLE: Above Cali, No. *445*, June 9, 1929.

Known also from Chile, Bolivia, Argentina, North America, Europe, Asia, and Australia; the distribution is coextensive with the cultivation of wheat.

In North America this rust has a list of 150 species of telial hosts and over 60 species of aecial hosts.

288. PUCCINIA CONOCLINII Seym.; Burrill, Bot. Gaz. **9**: 191. 1884.

Uredo Agerati Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 595. 1913.

Uredo Eupatorium Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 596. 1913.

On *Ageratum conyzoides* L.

CALDAS: Quindio River, near Armenia, No. *741*, July 14, 1929.

ANTIOQUIA: *Mayor.*

On *Ageratum conyzoides* L. var. *inaequipaleaceum* Hieron.

CUNDINAMARCA: *Mayor.*

On *Eupatorium densum* Benth.

CUNDINAMARCA: Slopes of Salto de Tequendama, No. *649*, July 6, 1929.

On *Eupatorium guadalupense* Spreg.

ANTIOQUIA: *Mayor.*

On ***Eupatorium iresinoides*** H. B. K.

ANTIOQUIA: *Mayor.*

On *Eupatorium Vargassianum* DC.

ANTIOQUIA: *Mayor.*

Known also in the United States, Mexico, Central America, and the West Indies.

PUCCINIA CONVOLVULACEAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 488. 1913.

On Convolvulaceae.

SANTANDER: *Mayor.*

289. PUCCINIA CRASSIPES Berk. & Curt. Grevillea **3**: 54. 1874.

Puccinia Ipomoeae-panduratae Sydow. Monog. Ured. **1**: 323. 1902.

On Ipomoeae.

CUNDINAMARCA: Girardot (R. A. Toro) No. *405*, Feb. 15, 1929.

ANTIOQUIA: *Mayor.*

ANTIOQUIA: *Chardon.*

On *Ipomoeae* aff. *caloneura* Meiss.

ANTIOQUIA: *Mayor.*

Known also in the southern United States, Mexico, Central America and the West Indies.

290. PUCCINIA CUNDINAMARCENSIS Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 536. 1913.

On *Verbesina verbascifolia* Walp.

CUNDINAMARCA: *Mayor.*

On *Verbesina* (?) *nudipes* Blake.

EL VALLE: Hacienda Bitaco, No. *480*, June 10, 1929.

On *Verbesina* sp.

EL VALLE: Above Cali, No. *449*, June 9, 1929.

*291. PUCCINIA CYNODONTIS Lacroix, *in* Desmaz. Pl. Crypt. II. 655. 1859.

On *Capriola dactylon* (L.) Kuntze.

ANTIOQUIA: Medellín (R. A. Toro) No. *184*, March 5, 1927.

Widely distributed on all the continents; in South America reported also from Brazil. This is the first report from Colombia.

*292. PUCCINIA CYPERI Arth. Bot. Gaz. **16**: 226. 1891.
On *Cyperus caracasanus* Kunth.
EL VALLE: Banks of Cauca River near Cali, No. *312*, May 21, 1929.
On *Cyperus globulosus* Aubl.
EL VALLE: Road from Cali to Palmira, No. *230*, May 11, 1929.

Known also from Brazil, Bolivia, United States, Mexico, Central America, and the West Indies. Apparently the first report from Colombia.

293. PUCCINIA DICHOROMENAE (Arth.) Jackson, Trans. Birth. Myc. Soc. **13**: 16. 1928.
Uredo Dichromenae Arth. Bull. Torrey Club **33**: 31. 1906.
On *Dichromena ciliata* Vahl.
CALDAS: Along Quindio River, near Armenia, No. *725*, July 14, 1929.
On *Dichromena polystachys* Turril.
ANTIOQUIA: *Mayor.*
On *Dichromena radicans* Cham. & Schlecht.
ANTIOQUIA: *Mayor.*
On *Dichromena* sp.
TOLIMA: Along Combeima River, No. *566*, June 20, 1929.
Known also from Bermuda and the West Indies.

PUCCINIA DOLORIS Speg. Anal. Soc. Cien. Arg. **12**: 23. 1881.
On *Erigeron* cf. *uliginosus* Benth.
ANTIOQUIA: *Mayor.*
Known also from the type locality in Argentina.

PUCCINIA DUBIA Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 482. 1913.
On Ampelidaceae.
ANTIOQUIA: *Mayor.*

*294. PUCCINIA EPIPHYLLA (L.) Wettst. Verh. Zool.—Bot. Ges. Wein. **35**: 541. 1886.
Puccinia poarum Niels. Bot. Tidsskr. III. **2**: 34. 1877.
On *Poa annua* L.
CUNDINAMARCA: La Picota Exp. Farm., South of Bogotá, No. *628*. June 30, 1929.
BOYACÁ: Duitama (R. A. Toro) No. *410*, Feb. 20, 1929.
On *Poa pratensis* Nielson.
CUNDINAMARCA: La Picota Exp. Farm., south of Bogotá, Nos. *616*, *631*, June 30, 1929.

Known also from Bolivia, Chile, Brazil, throughout continental North America, Europe, and Japan.

PUCCINIA EUPATORII Diet. Hedwigia **36**: 32. 1897.
On *Eupatorium ballotifolium* H. B. K.
ANTIOQUIA: *Mayor.*

PUCCINIA EUPATORIICOLA Mayor. Mem. Soc. Neuch. Sci. Nat. **5**: 513. 1913.
On *Eupatorium pycnocephalum* Less.
CUNDINAMARCA: *Mayor.*
On *Eupatorium Schiedeanum* Less.
ANTIOQUIA: *Mayor.*

PUCCINIA EUPATORII-COLUMBIANI Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 514. 1913.
On *Eupatorium columbianum* Herring.
ANTIOQUIA: *Mayor.*

PUCCINIA EVADENS Harkn. Bull. Calif. Acad. **1**: 34. 1884.
On *Baccharis cassinaefolia* DC.
ANTIOQUIA: *Chardon.*

Known also in southwestern United States, Mexico, and the West Indies.

*295. PUCCINIA FILOPES Arth. & Holw. Mycologia **10**: 131. 1918.
On *Buettneria carthaginensis* Jacq.
EL VALLE: Forest at Hacienda Riopaila, south of Zarzal, No. *382*, May 31, 1929.

Known also in Central America. Appears to be the first report of the species from Colombia.

PUCCINIA FIMBRYSTILIDIS Arth. Bull. Torrey Club **33**: 28. 1906.
On *Fimbrystilis annua* (All.) H. & S.
ANTIOQUIA: *Mayor.*

PUCCINIA FUHRMANNI Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 507. 1913.
On *Justicia* cf. *secunda* Vahl. cf. var. *intermedia* (Nees) Thellung.
ANTIOQUIA: *Mayor.*

*296. PUCCINIA GLUMARUM (Schum.) Erikks. & Henn., Zeits. Pflanzenkr. **4**: 197. 1894.
On *Triticum aestivum* L. var. *kota.*
CUNDINAMARCA: La Picota Exp. Farm. south of Bogotá, No. *635*, June 30. 1929.

Also in Chile, Ecuador, the United States, Mexico, Europe, Africa, and Japan.

PUCCINIA GONZALEZI Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 502. 1913.
On *Capsicum* sp.
CUNDINAMARCA: *Mayor.*

*297. PUCCINIA GOUANIAE Holw. Myc. **3**: 21. 1905.
On *Gouania* sp.
ANTIOQUIA: La Camelia, Angelopolis (R. A. Toro) No. *293*, Jan. 22, 1928.

298. PUCCINIA HETEROSPORA Berk & Curt., Berk. Jour. Linn. Soc. **10**: 356. 1869.
On *Abutilon umbellatum* (L.) Sweet.
TOLIMA: *Mayor.*
On *Anoda cristata* (L.) Schlecht.
ANTIOQUIA: *Mayor.*
On *Anoda hastata* Cav.
ANTIOQUIA: Medellín (R. A. Toro) No. *195*. April 4, 1927.
On *Bastardia viscosa* (L.) H. B. K.
TOLIMA: *Mayor.*
On *Malvastrum peruvianum* (L.) A. Gray.
BOYACÁ: Duitama (R. A. Toro) No. *409*, Feb. 20, 1929.
On *Sida rhombifolia* L.
CALDAS: Ravines near Armenia, No. *549*, June 19, 1929.
On *Sida spinosa* L.
EL VALLE: Finca Santa Bárbara, Palmira, No. *283*, May 15, 1929.
ANTIOQUIA: *Chardon.*
On *Wissadula periplocifolia* (L.) Presl.
TOLIMA: *Mayor.*
On Malvaceae.
EL VALLE: Near Rozo, northwest of Palmira, No. *325*, May 21, 1929.
ANTIOQUIA: *Mayor.*
A widespread rust in the tropical regions of both hemispheres.

299. PUCCINIA HUALLAGENSIS P. Henn. Hedwigia **43**: 158. 1904.
On *Solanum* aff. *myrianthum* Britt.
CUNDINAMARCA: Girardot, (R. A. Toro) No. *403*. Feb. 15, 1929.
On *Solanum torvum* Sw.
EL VALLE: Finca Las Cañas, South of Jamundi. No. *274*, May 15, 1929.

On *Solanum* aff. *torvum* Sw.
ANTIOQUIA: *Mayor.*

300. PUCCINIA HYDROCOTYLES (Link) Cooke, Grevillea **9**: 14. 1880.
On *Hydrocotyle leucocephala* Cham.
ANTIOQUIA: *Mayor.*
On *Hydrocotyle quinqueloba* Ruiz & Pav. var. *stella* (Pohl.) Urban.
ANTIOQUIA: *Mayor.*
On *Hydrocotyle umbellata* L.
ANTIOQUIA: Medellín, (R. A. Toro) No. *249*, Sept. 3, 1927.
CUNDINAMARCA: *Mayor.*

Known also in North America, the West Indies, Europe, and New Zealand.

PUCCINIA HYPTIDIS Tracy & Earle, Bull. Miss. Agr. Exp. Sta. **34**: 86. 1895.
On *Hyptis capitata* Jacq. var. *vulgaris* Briq.
ANTIOQUIA: *Mayor.*

PUCCINIA HYPTIDIS-MUTABILIS Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 496. 1913.
On *Hyptis mutabilis* (Rich.) Briq. var. *polystachya* H. B. K..
ANTIOQUIA: *Mayor.*
On *Hyptis mutabilis* (Rich.) Briq. var *spicata* (Poit) Briq.
ANTIOQUIA: *Mayor.*

*301. PUCCINIA IMPEDITA Mans & Holw; Arth. Mycologia **10**: 135. 1918.
On *Salvia petiolaris* H. B. K.
ANTIOQUIA: Boquerón, (R. A. Toro) No. *295*, Jan. 5, 1928.

Known also from Mexico, Central America, and the West Indies.

302. PUCCINIA LANTANAE Farl. Proc. Am. Acad. **18**: 83. 1883.
On *Lantana camara* L.
ANTIOQUIA: Medellín (R. A. Toro) No. *180*, March 19, 1927.
On *Lantana hispida* H. B. K.
ANTIOQUIA: *Mayor.*
On *Lantana tiliifolia* Cham.
TOLIMA: *Mayor.*
On *Lantana trifolia* L.
ANTIOQUIA: *Mayor.*
TOLIMA: *Mayor.*

303. PUCCINIA LATERITIA Berk & Curt. Jour. Phila. Acad. Sci. **2**: 281. 1853.

On *Borreria laevis* (Lam.) Griseb.

ANTIOQUIA: Medellín (R. A. Toro) No. *194*, April 4, 1927; Salgar (R. A. Toro) No. *376*, July 20, 1928.

EL VALLE: Candelaria No. *327*, May 21, 1929.

ANTIOQUIA: *Mayor.*

EL VALLE: *Mayor.*

On *Borreria latifolia* (Aubl.) Schum.

CALDAS: Ravine near Armenia, No. *548*, June 19, 1929.

CUNDINAMARCA: Granja La Esperanza, No *587*, June 23, 1929.

CALDAS: Along Quindio River, No. *721*, July 14, 1929.

TOLIMA: Along Combeima River near Ibagué, No. 667, June 20, 1929.

Recorded also from the United States, Mexico, Central America, and the West Indies.

*304. PUCCINIA LEONOTIDIS (P. Henn.) Arth. Mycologia **7**: 245. 1915.

Puccinia Leonotidicola P. Henn. in H. Baum, Kun. Samb. Exp. **2**: 1903.

On *Leonotis nepetaefolia* (L.) R. Br.

NARIÑO: Tumaco (R. A. Toro) No. *558*. Oct. 5, 1929.

EL VALLE: Exp. Station Grounds, Palmira, No. *263*, May 15, 1929; Hacienda El Hatico, between Cerrito and Palmira, No. *359*, May 23, 1929.

TOLIMA: Outskirts of Ibagué No. *554*, June 20, 1929.

CUNDINAMARCA: Granja La Esperanza, No. *592*, June 23, 1929.

PUCCINIA LEVIS (Sacc. & Bizz.) Magn. Ber. Deuts. Bot. Ges. **9**: 190. 1891.

Puccinia Paspali Tracy & Earle, Bull. Torrey Club **22**: 174. 1895

On *Axonopus scoparius* (Fl.) Hitch.

ANTIOQUIA: *Chardon.*

On *Manisuris granularis* Sw. (Sydow Monog. Ured. **1**: 759. 1903.)

On *Paspalum Fournierianum* Ricker var. *maximum* Thellung.

ANTIOQUIA: *Mayor.*

On *Paspalum pilosum* Lam.

ANTIOQUIA: *Chardon.*

Known also in Bolivia, Ecuador, Paraguay, Venezuela, Argentina, southern United States, Central America, and the West Indies.

PUCCINIA LIABI Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 539. 1913.

On *Liabum hastatum* (Wedd.) Britton.

ANTIOQUIA: *Mayor.*

CUNDINAMARCA: *Mayor.*

PUCCINIA MACROPODA Speg. Fungi Arg. Puig. II, No. 34: 1887.

On *Iresine* sp.

ANTIOQUIA: *Mayor.*

CUNDINAMARCA: *Mayor.*

305. PUCCINIA MALVACEARUM Bertero; Mont. in C. Gay. Fl. Chile 8: 43. 1852.

Puccinia Sidae-rhombifoliae Mayor, Mem. Soc. Neuth. Sci. Nat. 484. 1913.

On *Malvastrum corchorifolium* (Dest.) Britton.

CUNDINAMARCA: Granja La Esperanza, No. *589*, June 23, 1929.

On *Malvastrum coromandelianum* (L.) Garcke.

ANTIOQUIA: Medellín, (R. A. Toro) No. *177,* March 10, 1927; (R. A. Toro) No. *186,* March 5, 1927.

EL VALLE: Finca Rincón, along Pance River, No. *251*, May 14, 1929; Candelaria, No. *329*, May 21, 1929.

CUNDINAMARCA: Granja La Esperanza, No. *583*, June 23, 1929.

ANTIOQUIA: *Mayor.*

On *Malvastrum tricuspidatum* A. Gray (*M. americanum* Torr.)

EL VALLE: Exp. Station Grounds, Palmira, No. *289*, May 16, 1929.

On *Malvastrum* sp.

EL VALLE: Hacienda La Foresta, Pradera, No. *335*, May 21, 1929.

On *Sida rhombifolia* L.

ANTIOQUIA: *Mayor.*

EL VALLE: *Mayor.*

Known also in North America, the West Indies and nearly throughout the world where hollyhocks are grown.

PUCCINIA MARISCI Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 474. 1913.

On *Mariscus flavus* Vahl.

ANTIOQUIA: *Mayor.*

On *Mariscus hermaphroditus* (Jacq.) Urban.

ANTIOQUIA: *Mayor.*

CUNDINAMARCA: *Mayor.*

306. PUCCINIA MAYERHANSI Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 521. 1913.

On *Baccharis oronocensis* DC.

ANTIOQUIA: Granizales. (R. A. Toro) No. *291*. Sept. 11, 1927.

ANTIOQUIA: *Mayor.*

307. PUCCINIA MEDELLINENSIS Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 497. 1913.

On *Hyptis pectinata* (L.) Poit.

ANTIOQUIA: Medellín, (R. A. Toro) No. *271*, Dec. 29, 1929; *Mayor.*

Known also in Central America and the West Indies.

308. PUCCINIA MELAMPODII Diet. & Holw. Bot. Gaz. **24**: 43. 1897.

Puccinia Synedrellae P. Henn. Hedw. **37**: 277. 1898.

Puccinia Eleutherantherae Diet. Ann. Myc. **7**: 354. 1909.

Puccinia Wedeliae Mayor Mem. Soc. Neuch. Sci. Nat. **5**: 528. 1913.

Micropuccinia Melampodii Arth. & Jackson, N. Am. Fl. **7**: 581. 1922.

On *Eleutheranthera ruderalis* (Sw.) Sch.-Bip.

ANTIOQUIA: Fredonia, (R. A. Toro) No. *239*, July 31, 1927.

EL VALLE: Near Palmira, No. *292*, May 16, 1929; *Candelaria,* No *332*, May 21, 1929.

MAGDALENA: *Mayor.*

On *Eupatorium turbacense ovalifolium* Hieron.

ANTIOQUIA: La Camelia, Angelopolis (R. A. Toro) No. *292*.

CUNDINAMARCA: Granja La Esperanza, No. *588*, June 23, 1929.

On *Spilanthes ciliata* H. B. K.

EL VALLE: La Paz, Andalucia, No. *528*, June 7, 1929.

On *Synedrella nodiflora* (L.) Gaertn.

EL VALLE: Along Cauca River near Cali, No. *323*, May 21, 1929; Hacienda Bitaco, Cordillera Occidental, No. *492*, June 11, 1929.

ANTIOQUIA: *Chardon.*

ANTIOQUIA: *Mayor.*

CUNDINAMARCA: *Mayor.*

TOLIMA: *Mayor.*

On *Wedelia caracassana* DC.

ANTIOQUIA: *Chardon.*

On *Wedelia trichostephia* DC.

ANTIOQUIA: *Mayor.*

Known also through Central America and in the West Indies.

A common rust in the American tropics on various composite hosts. This is the first report of a species on *Eupatorium*.

*309. PUCCINIA MENTHAE Pers. Syn. Fung. 227. 1801.

On *Hyptis mutabilis spicata* (Poit.) Epl.

CUNDINAMARCA: Slopes of Salto de Tequendama, Nos. *643*, *643 b*, July 6, 1929.

Known also in North America, Europe, Asia, Africa, and Australia.

Apparently this is the first report from South America and also the first report on a species of *Hyptis*. Although known on a large number of genera and species of mints, the genus *Hyptis* does not appear to have been recorded. Aecia, uredinia, and telia are present and all agree very well.

PUCCINIA MONTOYAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 523. 1913.

On *Baccharis floribunda* H. B. K.

CUNDINAMARCA: *Mayor.*

PUCCINIA MONTSERRATES Mayor, Mem. Soc. Neuch. Sci. Nat **5**: 520. 1913.

On *Baccharis bogotensis* H. B. K.

CUNDINAMARCA: *Mayor.*

*310. **Puccinia Nariñensis** Kern and Whetzel sp. nov.

Telia hypophyllous, gregarious, in groups 0.5–2 mm. or more across, punctiform, 0.1–0.2 mm. across, compact, pulvinate, blackish brown; teliospores variable in shape, sometimes ellipsoid, obovoid, often flattened on one side, frequently with the pedicel obliquely attached, 18–23 x 26–35 u, apex rounded or truncate, base narrowed or oblique, slightly or not constricted at the septum, the wall chestnut brown, about 1.5 u, darker and usually thicker above, smooth, the pedicel fragile, about half length of spore.

On *Eupatorium* sp.

NARIÑO: Tumaco (R. A. Toro) No. *557*, Oct. 5, 1929. (type).

A microcyclic species differing in spore characters from *P. eupatoriicola* and *P. tolimensis*. The new species has spores that are broader, much shorter, and considerably darker in color. It does not agree with any described short-cycle species on *Eupatorium* or closely related host.

PUCCINIA ORTIZI Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 503. 1913.

On *Brachistus* aff. *hebephyllus* Miers.

CUNDINAMARCA: *Mayor.*

311. PUCCINIA OXALIDIS (Lev.) Diet. & Ellis; Dietel, Hedwigia **34**: 291. 1895.

Uredo Oxalidis Lev. Ann. Sci. Nat. **11**: 16. 1841.

Trichobasis Oxalidis Lev. Ann. Sci. Nat. IV. **20**: 299. 1863.

On *Oxalis pubescens* H. B. K.

ANTIOQUIA: Medellín No. *192* (R. A. Toro), April 4, 1927.

CUNDINAMARCA: (reported by Leveille.)

On *Oxalis* sp.

EL VALLE: Above Cali, No. *442*, June 4, 1929.

Known also in North America and the West Indies.

This appears to be the first rust reported from Colombia.

It is listed by Leveille in the Prodromus Florae Novo. Granatensis Cryptogamie (Triana, J. and Planchon, J. E.) which was published in 1863.

PUCCINIA OYEDAEAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 535. 1913.

On *Oyedaea* aff. *buphthalmoides* DC.

ANTIOQUIA: *Mayor.*

312. PUCCINIA PALLESCENS Arth. Bull. Torrey Club **46**: 111. 1919.

On *Zea Mays* L.

EL VALLE: Hacienda La Foresta Pradera, No. *337*, May 21, 1929; plantations above Pavas, Cordillera Occidental, No. *509*, June 12, 1929.

ANTIOQUIA: *Chardon.*

Known also from Trinidad, Mexico, Central America, and the West Indies.

PUCCINIA PALLIDISSIMA Speg. Anal. Soc. Ci. Arg. **12**: 69. 1881.

Puccinia albida Diet. & Neg. Bot. Jahrb. **24**: 160. 1897.

On *Stachys Mayorii* Briq.

ANTIOQUIA: *Mayor.*

PUCCINIA PARAMENSIS Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 493. 1913.

On *Salvia cernua* H. B. K.

ANTIOQUIA: *Mayor.*

313. PUCCINIA PITTIERIANA P. Henn. Hedwigia **42**: 147. 1904.

On *Solanum tuberosum* L.

TOLIMA: Briceño, V. Sacco No. *537* (com. R. A. Toro), Feb. 5, 1930.

Known also from Ecuador, Paraguay, and Costa Rica.

314. PUCCINIA POCULIFORMIS (Jacq.) Wettst. Verh. Zool.—Bot. Ges. Wien. **35**: 544. 1886.

Puccinia graminis Pers. Neues Mag. Bot. **1**: 119. 1794.

On *Agrostis perennans* (Walt.) Tuckerm.

ANTIOQUIA: *Chardon.*

On *Anthoxanthum odoratum* L.

CUNDINAMARCA: Wet meadows above Salto de Tequendama, Nos. *660*, *664*, July 6, 1929.

On *Avena sativa* L.

CUNDINAMARCA: La Picota Exp. Farm, south of Bogotá, No. *632*, June 30, 1929.

On *Phleum pratense* L.

CUNDINAMARCA: La Picota Exp. Farm, south of Bogotá, No. *634*, June 30, 1929.

On *Stipa neesiana* Trin. & Rupr.

CUNDINAMARCA: La Picota Exp. Farm, south of Bogotá, No. *619*, June 30, 1929.

On *Triticum aestivum* L.

CUNDINAMARCA: La Picota Exp. Farm, south of Bogotá, No. *622*, June 30, 1929; Sibate, J. Díaz, No. *400*, Sept. 2, 1929.

Known in Perú, Chile, Bolivia, and in all parts of the world where cereal grains are cultivated; apparently less prevalent in South America and Europe.

315. PUCCINIA POLYGONI-AMPHIBII Pers. Syn. Fung. 227. 1801.

On *Persicaria hydropiperoides* (Michx.) Small.

CUNDINAMARCA: Meadows above Salto de Tequendama, No. *662*, July 6, 1929.

On *Persicaria persicarioides* (H. B. K.) Small.

CUNDINAMARCA: Ravine between Cerro Monserrate and Guadalupe, above Bogotá, No. *595*, June 23, 1929.

On *Persicaria punctata* (Ell.) Small (*Polygonum* acre H. B. K.)

CUNDINAMARCA: Ravine Cerro Monserrate and Guadalupe, above Bogotá, No. *608*, June 25, 1929.

ANTIOQUIA: Envigado (R. A. Toro) No. *243*, Aug. 5, 1927.

ANTIOQUIA: *Chardon; Mayor.*

Known also throughout North America, Europe, Africa, India, China, and Japan.

316. Puccinia Psidii Wint. Hedwigia **23**: 171. 1884.

Uredo Myrciae Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 590. 1913.

On *Jambos Jambos* (L.) Millsp.

Antioquia: Medellín (R. A. Toro) No. *300*, Jan. 20, 1928; *Chardon*

On *Myrcia* cf. *acuminata* (H. B. K.) DC.

Antioquia: *Mayor.*

On *Myrcia* sp.

Antioquia: Medellín (R. A. Toro) No. *306*, Jan. 20, 1928.

On *Psidium.* sp.

Antioquia: Medellín (R. A. Toro) No. *308*, Jan. 20, 1928.

On Myrtaceae sp.

Antioquia: Fredonia (R. A. Toro) No. *196*, April 10, 1927; La Camelia, Angelopolis, (R. A. Toro) No. *290*, Jan. 22, 1928; Medellín (R. A. Toro) No. *215*, Aug. 2, 1927; Salgar (R. A. Toro) No *374*, July 20, 1928.

Known also from Brazil and the West Indies.

Puccinia punctata Link, Ges. Nat. Freunde Berlin Mag. **7**: 30. 1815.

On *Relbunium hypocarpium* (L.) Hemsley.

Antioquia: *Mayor.*

The North American hosts are all species of *Galium.*

*317. Puccinia purpurea Cooke, Grevillea **5**: 15. 1876.

On *Holcus Sorghum* L.

El Valle: Hacienda La Foresta, Pradera, No. *338*, May 21, 1929.

Known also from Perú, Brazil, North America, the West Indies, Europe, Asia, Africa, and Hawaii.

*318. Puccinia Rhamni (Pers.) Wettst. Verh. Zool.—Bot. Ges. Wien. **35**: 545. 1886.

On *Agrostis perenans* (Walt.) Tuckerm.

Cundinamarca: Wet meadows above Salto de Tequendama, No. *661*, July 6, 1929.

Caldas: Ravines near Calarca, along Armenia–Ibagué road, No. *708*, July 6, 1929.

On *Avena sativa* L.

Boyacá: Duitama (R. A. Toro) No. *408*, Feb. 20, 1929.

Known also from Chile, Bolivia, Brazil, Ecuador, and on all continents.

Apparently the first report from Colombia. Not reported by Arthur from South America on the genus *Agrostis.*

319. PUCCINIA ROTUNDATA Diet. Hedwigia **36**: 32. 1897.

Puccinia rugosa Speg. Ann. Soc. Cien Arg. **17**: 92. 1884. Not. *P. rugosa* Billings, 1871.

On *Vernonia brasiliana* (L.) Druce.

EL VALLE: Near Santa Ana between Cartago and Cauca River, No. *372*, May 20, 1929; Hacienda El Hatico between Cerrito and Palmira, No. *358*, May 23, 1929.

On *Vernonia patens* H. B. K.

ANTIOQUIA: Medellín (R. A. Toro) No. *182*, March 19, 1927; Nos. *301*, *302*, Jan. 20, 1928.

On *Vernonia scabra* Pers.

TOLIMA: *Mayor*.

MAGDALENA: Santa Marta, H. H. Smith phan. spec. *613*, date?

Known also from Brazil and Central America.

PUCCINIA RUELLIAE (Berk. & Br.) Lagerh. Tromsö Mus. Aarch. **17**: 71. 1895.

Uredo balaensis Syd. Ann. Mycol. **1**: 21. 1903.

On *Blechum Brownei* Juss.

ANTIOQUIA: *Mayor*.

A common rust in the tropical regions of both hemispheres.

PUCCINIA RUIZENSIS Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 486. 1913.

On *Oreomyrrhris andicola* (H. B. K.) Endlicher.

ANTIOQUIA: *Mayor*.

PUCCINIA SALVIICOLA Diet. & Holw. Bot. Gaz. **24**: 33. 1897.

Uredo Salviarium Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 592. 1913.

On *Salvia cataractarum* Briq.

CUNDINAMARCA: *Mayor*.

On *Salvia Mayorii* Briq.

CUNDINAMARCA: *Mayor*.

On *Salvia petiolaris* H. B. K.

ANTIOQUIA: *Mayor*.

Known also in southern United States and Mexico.

PUCCINIA SAMPERII Mayor, Mem. Soc. Neuch, Sci. Nat. **5**: 499. 1913.

On *Chaenocephalus arboreus* (H. B. K.) O. Hoffm.

CUNDINAMARCA: *Mayor*.

PUCCINIA SARACHAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 499. 1913.

On *Saracha edulis* (Schlecht.) Thellung.

ANTIOQUIA: *Mayor.*

CUNDINAMARCA: *Mayor.*

On *Saracha* aff. *edulis* (Schlecht.) Thellung.

ANTIOQUIA: *Mayor.*

Known also in Central America and the West Indies.

*320. PUCCINIA SCHISTOCARPHAE Jacks. & Holw., Am. Jour. Bot. **5**: 334. 1918.

On *Schistocarpha* sp.

ANTIOQUIA: Medellín (R. A. Toro) No. *255*, Sept. 3, 1927.

Heretofore known only from Guatemala.

321. PUCCINIA SCLERIICOLA Arth. Mycologia **7**: 232. 1915.

On *Scleria melaleuca* Cham. & Schlecht.

ANTIOQUIA: *Mayor.*

On *Scleria* sp.

ANTIOQUIA: Fredonia (R. A. Toro) No. *233*, July 31, 1927.

Known also from Florida and the West Indies.

Apparently the first report from South America. Mayor reports the foregoing specimen on *Scleria melaleuca* as *Uromyces Scleriae* P. Henn. but that species has the urediniospore-wall 3–9 u thick above whereas Mayor says his spores have a uniform wall 2 u thick. Both his specimen and that of Toro seem best referred to *Puccinia scleriicola*.

*322. PUCCINIA SMILACIS Schw. Schr. Nat. Ges. Leipzig **1**: 72. 1822.

On *Smilax cumanensis* Willd.

TOLIMA: Along Combeima River, near Ibagué. No. *568*, June 20, 1929.

Known also from the United States, Mexico, and the West Indies. This is the first report from South America.

323. PUCCINIA SOLANITA (Schw.) Arth. Mycologia **14**: 19. 1922.

Puccinia claviformis Lagerh. Tromsö Mus. Aarch. **17**: 53. 1895.

Puccinia solanicola Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 505. 1913.

On *Solanum hirtum* Vahl.

TOLIMA: *Mayor.*

On *Solanum* aff. *ovalifolium* H. & B.

CUNDINAMARCA: *Mayor.*

On *Solanum stramonifolium* Jacq.

Antioquia: Medellín (R. A. Toro) No. *183*, March 19, 1927.

On *Solanum torvum* Sw.

Antioquia: Medellín (R. A. Toro) No. *187*, March 5, 1927.

Tolima: Along Combeima River, near Ibagué, No. *750*, June

Tolima: Along Combeima River, near Ibagué, No. *570*, June 20, 1929.

On *Solanum* sp.

Antioquia: *Chardon*.

Tolima: *Mayor*.

Cundinamarca: *Mayor*.

Magdalena: C. F. Barker No. *76*, (reported by Earle, Bull. Torrey Club **26**: 632).

El Valle: Along road near Pradera, No. *339*, May 23, 1929.; Hacienda El Hitaco between Cerrito and Palmira, No. *357*, May 23, 1929.

Known also in Central America.

Puccinia soledadensis Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 494. 1913.

On *Salvia ? panciserrata* Benth.

Tolima: *Mayor*.

324. Puccinia Sorghi Schw. Trans. Am. Phil. Soc. II. **4**: 295. 1852.

Puccinia Maydis Berebg. Atti. Sci. Ital. **6**: 475. 1845 (hyponym.)

On *Zea Mays* L.

El Valle: Near Rozo, northwest of Palmira, No. *399*, May 31, 1929.

Antioquia: *Mayor*.

325. Puccinia Spegazzinii De-Toni, in Sacc. Syll. Fung. **7**: 704. 1888.

On *Mikania cordifolia* (L.) Willd.

El Valle: Finca Las Cañas, south of Jamundi, No. *277*, May 15, 1929.

Cundinamarca: Granja La Esperanza, No. *582*, June 23, 1929.

Tolima: El Boquerón, west of Ibagué along Armenia road, No. *698*, July 13, 1929.

On *Mikania scandens* (L.) Willd.

Antioquia: *Mayor*.

On *Mikania* sp.

Antioquia: Medellín (R. A. Toro) No. *250*, Sept. 3, 1927; Salgar, (R. A. Toro) No. *360*, July 20, 1928.

Known also in Argentina, North America, the West Indies, Martinique, and Trinidad.

326. PUCCINIA SPILANTHICOLA Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 531. 1913.

On *Spilanthes americana* (Mutis) Hieron.
ANTIOQUIA: *Mayor.*

On *Spilanthes ciliata* H. B. K.
EL VALLE: Candelaria, No. *326*, May 21, 1929.
TOLIMA: Along Combeima River near Ibagué, No. *571*, June 20, 1929; El Boquerón, west of Ibagué along Armenia road, No. *695*, June 13, 1929.
ANTIOQUIA: *Mayor.*

Except for the mesospores, which are numerous in this species, it is very like *Puccinia Melampodii.*

PUCCINIA SUBCORONATA P. Henn. Hedwigia **34**: 94. 1895.
Puccinia antioquiensis Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 473. 1913.

On *Cyperus diffusus* Vahl.
ANTIOQUIA: *Mayor.*

Known also in Bolivia, Brazil, British Guiana, Trinidad, and Central America.

According to Jackson the differences on which Mayor separated *P. antioquiensis* from *P. subcoronata* do not hold when more ample material is taken into account and he has united the two.

327. PUCCINIA SUBDIGITATA Arth. & Howl.; Arth Am. Jour. Bot. **5**: 468. 1918.

On *Brachypodium mexicanum* Link.
CUNDINAMARCA: Ravines between Cerro Monserrate and Guadalupe, above Bogotá, No. *611*, June 25, 1929.

Known also in Bolivia and the type locality in Guatemala.

328. PUCCINIA SUBSTRIATA Ellis & Bart. Erythea **5**: 47. 1897.
Uredo Henningsii Sacc. Syll. Fung. **17**: 456. 1905.

An explanation must be made regarding the use of this name in connection with Colombian rusts. The name appears in Mayor's work but the specimen cited is from Jamaica and not Colombia. The name *Uredo Henningsii* listed by Mayor is a synonym of *Puccinia substriata* but the specimen on *Panicum lanatum* which he refers to that species seems without doubt to be *Uromyces leptodermus.*

On *Chaetochloa geniculata* (Lam.) Millsp.

EL VALLE: Banks of Cauca River near Cali, No. *324*, May 21, 1929.

On *Paspalum paniculatum* L.

EL VALLE: Hacienda Bitaco, Cordillera Occidental, No. *478*, June 10, 1929.

Known also from Brazil, Perú, Bolivia, North America, and the West Indies.

329. PUCCINIA TAGETICOLA Diet. & Howl.; Holway, Bot. Gaz. **24**: 26. 1897.

On *Tagetes microglossa* Benth.

ANTIOQUIA: *Mayor.*

On *Tagetes patula* L.

ANTIOQUIA: Fredonia, (R. A. Toro) No. *244*, Aug. 14, 1927.

Known also in Mexico, Central America, and the West Indies.

330. PUCCINIA TOLIMENSIS Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 516. 1913.

On *Eupatorium turbacense* Hieron.

ANTIOQUIA: Angelopolis, (R. A. Toro) No. *343*, Jan. 22, 1928.

On *Eupatorium* sp.

TOLIMA: *Mayor.*

Known also in Guatemala, and one locality in New York.

331. PUCCINIA TUBULOSA (Pat. & Gaill.) Arth. Am. Jour. Bot. **5**: 464. 1918.

Uredo paspalicola P. Henn. Hedwigia **44**: 57. 1905.

On *Paspalum conjugatum* Berg.

ANTIOQUIA: Parque Independencia, Medellín (R. A. Toro) No. *253*, Sept. 3, 1927.

EL VALLE: Banks of Cauca River near Cali, No. *321*, May 21, 1929.

ANTIOQUIA: *Mayor.*

On *Paspalum Humboldtianum* Flugge.

TOLIMA: El Boquerón, west of Ibagué along Armenia road, No. *697*, July 13, 1929.

On *Paspalum paniculatum* L.

EL VALLE: Finca Las Cañas, south of Jamundi, No. *271*, May 15, 1929; along Cauca River near Cali, No. *434*, June 8, 1929.

CALDAS: Ortegadiaz R. R. Station, route from Zarzal to Armenia, No. *540*, June 19, 1929.

Known also in Brazil, Bolivia, Central America, the West Indies, and Asia.

PUCCINIA VERNONIAE-MOLLIS Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 510. 1913.

Aecidium Vernoniae-mollis Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 570. 1913.

The aecia described by Mayor as *Aecidium Vernoniae-mollis* are from the same locality as two of the collections of *Puccinia*. Jackson (Bot. Gaz. **65**: 296, 1918) believes that these aecia belong in the life history of this species. The identity of *Uredo Vernoniae* Mayor remains in doubt.

On *Vernonia* cf. *mollis* H. B. K.

ANTIOQUIA: *Mayor.*

On *Vernonia* sp.

CUNDINAMARCA: Granja La Esperanza, No. *591*, June 23, 1929.

ENDOPHYLLUM Lev. Mem. Soc. Linn. Paris **4**: 208. 1825.

332. ENDOPHYLLUM CIRCUMSCRIPTUM (Schw.) Whet. & Olive, Am. Jour. Bot **4**: 49. 1917.

Aecidium circumscriptum Schw.; Berk. & Curt. Jour. Phila. Acad. Sci. II. **2**: 283. 1853.

Aecidium Cissi Wint. Hedwigia **23**: 168. 1884.

On *Cissus sicyoides* L. (*Vitis sicyoides* (L.) Baker).

ANTIOQUIA: Fredonia (R. A. Toro) No. *206*, July 30, 1927.; Titiribi (R. A. Toro) No. *268*, Aug. 8, 1927.

EL VALLE: Finca Las Cañas, south of Jamundi, No. *275*, May 15. 1929.

ANTIOQUIA: *Mayor.*

On *Cissus* sp. (*Vitis* sp.)

CUNDINAMARCA: *Mayor.*

Known also from Surinam, Central America, the West Indies, and Trinidad.

333. ENDOPHYLLUM DECOLORATUM (Schw.) Whet. & Olive, Am. Jour. Bot. **4**: 49. 1917.

Aecidium Wedeliae Earle, Muhlenbergia **1**: 16. 1901.

Aecidium Clibadii Sydow, Ann. Myc. **1**: 333. 1903.

On *Clibadium surinamense* L.

ANTIOQUIA: Fredonia; (R. A. Toro) No. *200*, July 31, 1927.; (R. A. Toro) No. *241*, Aug. 1, 1927.

EL VALLE: La Paz, Andalucia, No. *532*, June 7, 1929.
TOLIMA: El Boquerón, west of Ibagué, No. *701*, July 13, 1929.
On *Clibadium surinamense asperum* (Aublet) Baker.
ANTIOQUIA: *Mayor.*

Known also from Surinam, Mexico, Central America, the West Indies, and Trinidad.

334. ENDOPHYLLUM STACHYTARPHETAE (P. Henn.) Whet. & Olive, Am. Jour. Bot. **4**: 50. 1917.

Aecidium Stachytarphetae P. Henn. Hedwigia Beibl. **38**: 71. 1899.

On *Valerianodes cayennense* (L. C. Rich.) Kuntze, (*Stachytarpheta cayennensis* (Rich.) Vahl.)
ANTIOQUIA: Angelopolis, (R. A. Toro) No. *228*, July 27, 1927.
TOLIMA: Ravines along road near Ibagué, No. *560*, June 20, 1929.
NARIÑO: Tumaco, (R. A. Toro) No. *554*, Oct. 5, 1929.
ANTIOQUIA: *Mayor.*

Known also in Brazil, the West Indies, and Panamá.

ENDOPHYLLOIDES Whet. & Olive, Am. Jour. Bot. **4**: 50. 1917.

*335. ENDOPHYLLOIDES PORTORICENSIS Whet. & Olive, Am. Jour. Bot. **4**: 50. 1917.

On *Mikania Guaco* H. & B.
TOLIMA: Along Combeima River near Ibagué, No. *575*, June 20, 1929.

Known also from Panamá, Guatemala, Salvador, and Trinidad.

This is the first report of this species from Colombia.

ALVEOLARIA Lagerh. Ber. Deuts. Bot. Ges. **9**: 346. 1891.

336. ALVEOLARIA CORDIAE Lagerh. Ber. Deuts. Bot. Ges. **9**: 346. 1891.

On *Cordia ferruginea* (Lam.) R. & S.
TOLIMA: Ravines along road near Ibagué, No. *562*, June 20, 1929.
On *Cordia laxiflora* H. B. K.
ANTIOQUIA: *Mayor.*

Known also in Ecuador and Jamaica.

PUCCINIOSIRA Lagerh. Ber. Deutsh. Bot. Ges. **9**: 344. 1891.

337. PUCCINIOSIRA PALLIDULA Speg.) P. Henn. Tromsö Mus. Aarsb.

On *Pavonia paniculata* Cav.

On Malvaceae sp.

ANTIOQUIA: *Mayor* (a doubtful reference).

Pavonia paniculata Cav.

ANTIOQUIA: *Mayor.*

On *Triumfetta semitriloba* Jacq.

ANTIOQUIA: Titiribi, (R. A. Toro) No. *267*, Aug. 8, 1927.

On *Triumfetta* sp.

EL VALLE: Finca Rincón, south of Cali, No. *257*, May 14, 1929; Santa Ana, No. *342*, May 23, 1929; thickets near San Pedro, north of Buga, No. *422*, June 11, 1929; Hacienda Bitaco, Cordillera Occidental, No. *491*, June 11, 1929.

Known also in Paraguay, Mexico, the West Indies, and Trinidad.

AECIDIUM (Form Genus)

338. AECIDIUM ADENARIAE Mayor, Mem. Soc. Neuch. Nat. Sci. **5**: 556. 1913.

On *Adenaria floribunda* H. B. K.

ANTIOQUIA: Medellín, (R. A. Toro) No. *305*, Jan. 20, 1928.

On *Adenaria floribunda purpurata* (H. B. K.) Kiehne.

ANTIOQUIA: *Mayor.*

AECIDIUM BOGOTENSE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 563. 1913.

On *Geranium multiceps* Turcz.

CUNDINAMARCA: *Mayor.*

AECIDIUM BOMAREAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**:559. 1913.

On *Bomarea* cf. *Caldasii* (H. B. K.) Willd.

CUNDINAMARCA: *Mayor.*

On *Bomarea potacocensis* Herb.

CUNDINAMARCA: *Mayor.*

AECIDIUM BORRERIAE Pat. Mem. Soc. Neuch. Sci. Nat. **5**: 569. 1913.

On *Hemidiodia ocimifolia* (Willd.) K. Schum.

ANTIOQUIA: *Mayor.*

*339. **Aecidium Capsici** Kern and Whetzel sp. nov.

Aecia chiefly hypophyllous, caulicolous, or petiolicolous, gregarious, capitulate, 0.2–0.3 mm. in diameter; peridium whitish, fragile, the margin erect, the peridial cells hexagonal-oval in face view, the inner wall rugose-verrucose, 19–29 u long; aecia-spores angularly oval, 13–18 x 16–24 u, the wall colorless, 1.5–2.5 u thick, finely verrucose.

We have found no rust of this sort on *Capsicum* or related hosts.

No pycnia were found by careful sectioning. It is entirely possible that these spores may germinate with promycelia but it is not possible to tell by examining these specimens.

On *Capsicum baccatum* L.

ANTIOQUIA: Fredonia, (R. A. Toro) No. *197*, April 10, 1927. (type).
EL VALLE: Coffee plantation above Pavas, Cordillera Occidental, No. *510*, June 12, 1929.

*340. **Aecidium Erigerontis** Kern and Whetzel sp. nov.

Pycnia amphigenous, few, chiefly hypophyllous in the center of circinating aecial groups, subepidermal flattened globoid, 95–115 u broad by 60–80 u high, ostiolar filaments up to 60 u long.

Aecia hypophyllous, gregarious, in groups 0.2–0.4 mm. across, minute cupulate about 0.1 mm. in diameter; peridium whitish, the margin erect or recurved, lacerate; peridial cells angularly oval, 26–39 u long, the inner wall closely rugose-verrucose; aeciospores obovoid or ellipsoid, often angular and narrowed above, 15–21 x 21–31 u, the wall colorless 1.5–2 u, much thicker above, 4–7 u, finely verrucose.

The noteworthy feature of this species is the thickening of the upper part of the aeciospore-wall.

On *Erigeron bonariensis* L.

EL VALLE: Dry tickets near San Pedro, north of Buga, No. *424*, June 4, 1929. (type).

AECIDIUM GYMNOLOMIAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 574. 1913.

On *Gymnolomia quitensis* (Benth.) Benth. & Hook.

CUNDINAMARCA: *Mayor.*

341. AECIDIUM HELIOPSIDIS Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 573. 1913.

On *Heliopsis buphthalmoides* (Jacq.) Dunal.

ANTIOQUIA: La Camelia, Angelopolis (R. A. Toro) No. *320*, Jan. 22. 1928.
ANTIOQUIA: *Mayor.*
CUNDINAMARCA: *Mayor.*

AECIDIUM LANTANAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 567. 1913.

On *Lantana hispida* H. B. K.

ANTIOQUIA: *Mayor.*

AECIDIUM LIABI Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 576. 1913.

On *Liabum igniarum* (Humb. & Bompl.) Less.

ANTIOQUIA: *Mayor.*

***342. Aecidium Manettiae** Kern and Whetzel sp. nov.

Pycnia amphigenous or caulicolous, intermingled with the aecia, becoming blackish, flattened globoid, deep-seated, 160–190 u broad by 130–160 u high; ostiolar filaments not projecting to any extent.

Aecia amphigenous, caulicolous, or petiolicolous, gregarious, sometimes extending along the stems for several cm., deep-seated, hemispheric with irregular rupture; peridium not much exserted; peridial cells oblong or somewhat rhomboidal, 55–65 long, the outer wall 1.5 u, the inner wall 5–6 u, the inner and side walls rugose; aeciospores broadly ellipsoid, 19–26 x 31–37 u, the wall colorless, about 1.5 u, thick, closely and coarsely verrucose.

There is a species of *Puccinia* and also of *Uromyces* on this host genus but both seem to be microcyclic judging from the description. We have found no aecial stage to which this collection could be referred.

On *Mannettia Toroi* Standley.

ANTIOQUIA: Salgar, (R. A. Toro) No. *331*, July 20, 1928. (type).

AECIDIUM PARAMENSE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 571. 1913.

On *Eupatorium obscurifolium* Hieron.

CUNDINAMARCA: *Mayor.*

AECIDIUM SPEGAZZINII DeToni, Sacc. Syll. Fung. **7**: 802. 1888.

On *Erigeron bonariensis* L.

There is a strong possibility that this may be the aecial stage of the Carex rust, *Puccinia Asterum* (Schw.) Kern.

CUNDINAMARCA: *Mayor.*

UREDO (Form Genus)

***343.** UREDO ANTHURII (Hariot) Sacc. Syll. Fung. **11**: 229. 1895.

On *Anthurium* sp.

EL VALLE: Mountains above Cali, No. *458*, June 10, 1929.

Known also from the type locality, green-houses of the Jardin des Plantes in Paris, and a single collection from Porto Rico.

A rare species. This is the first collection from South America.

***344.** UREDO ARTOCARPI Berk. & Br. Jour. Linn. Soc. **14**: 93. 1873.

On *Artocarpus communis* Forst.

EL VALLE: Finca Santa Bárbara, Palmira, No. *282*, May 16, 1929.

Known also from Cuba, Porto Rico, Santo Domingo, and India. This is the first report from South America.

UREDO BACCHARIDIS-ANOMALAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 597. 1913.

On *Baccharis anomala* DC.

CUNDINAMARCA: *Mayor.*

UREDO CALEAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 598. 1913.

On *Calea glomerata* Klatt.

ANTIOQUIA: *Mayor.*

345. UREDO CHERIMOLIAE Lagerh. Bull. Soc. Myc. Fr. **11**: 215. 1895.

On *Annona cherimolia* Mill.

EL VALLE: Finca Piedra Grande, south of Cali, No. *243*, May 14, 1929.

CALDAS: Along Quindio River near Armenia, No. *711*, July 14, 1930.

ANTIOQUIA: *Chardon.*

*346. **Uredo Cordiorum** Kern and Whetzel sp. nov.

Uredinia hypophyllous, scattered or somewhat gregarious, roundish, 0.5–0.8 mm. across, early naked, pulverulent; urediniospores broadly ellipsoid, globoid, or obovoid. 23–29 x 29–35 u, the wall cinnamon-brown, 3–3.5 u thick, not or only slightly thicker above, closely echinulate with coarse hyaline papillae, the pores 2, equatorial.

Although there are several species of rust on *Cordia* there is no uredinial stage which is at all similar to this. Both *Uromyces Cordiae* P. Henn. and *Uredo Cordiae* P. Henn. have the urediniospore-wall thickened above up to 10 u.

On *Cordia cylindrostachya* (R. & P.) Ros.

CUNDINAMARCA: Slopes of Salto de Tequendama, No. *646*, July 6, 1929.

UREDO CUNDINAMARCENSIS Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 591. 1913.

On *Apium ternatum* (Willd.) Thellung var. *ranunculifolium* (H. B. K.) Thelung.

CUNDINAMARCA: *Mayor.*

347. UREDO CUPHEAE P. Henn. Hedwigia **34**: 99. 1895.

On *Parsonsia pinto* (Vand.) Hiller.

CALDAS: Near Armenia No. *545*, June 19, 1929.

ANTIOQUIA: *Chardon.*

On *Parsonsia racemosa* (L. f.) Standley.

EL VALLE: Mountains above Cali, No. *452*, June 9, 1929.

On *Cuphea serphyllifolia* H. B. K.
ANTIOQUIA: *Mayor.*
On *Cuphea strigulosa* H. B. K.
TOLIMA: El Boquerón, along Armenia road, west of Ibagué, No. *702*, July 13, 1929.
On *Parsonsia* sp.
ANTIOQUIA: Medellín, (R. A. Toro) No. *176*, March 10, 1927; April 3, 1927.
Known also from the West Indies.

UREDO CYATHULAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 584. 1913.
On *Cyathula achyranthoides* (H. B. K.) Moq.
CUNDINAMARCA: *Mayor.*

UREDO GUACAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 583. 1913.
On *Epidendrum* sp.
ANTIOQUIA: *Mayor.*

UREDO HYMENAEAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 585. 1913.
On *Hymenaea* sp.
ANTIOQUIA: *Mayor.*

UREDO HYPTIDIS-ATRORUBENTIS Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 593. 1913.
On *Hyptis atrorubens* Poit.
ANTIOQUIA: *Mayor.*

*348. UREDO JATROPHICOLA Arth. Mycologia **7**: 331. 1915.
On *Jatropha gossypifolia* L.
EL VALLE: Near San Pedro, north of Buga, No. *427*, June 4, 1930.

349. UREDO KYLLINGAE P. Henn. Hedwigia **35**: 256. 1896.
On *Kyllingae brevifolia* Vahl.
ANTIOQUIA: *Mayor.*
On *Kyllinga odorata* Vahl.
ANTIOQUIA: *Mayor.*
On *Kyllinga* sp.
CUNDINAMARCA: Along road beyond Salto de Tequendama, No. *677*, July 7, 1929.

UREDO MANDEVILLIAE Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 591. 1913.
On *Mandevilla* cf. *mollisima* (H. B. K.) Schum.
ANTIOQUIA: *Mayor.*

UREDO NEPHROLEPIDIS Dietel; Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 576. 1913.

On *Nephrolepis pendula* Radii.

ANTIOQUIA: *Mayor.*

350. UREDO NOCIVIOLA Jackson & Holway, Mycologia **13**: 144. 1926.

On *Cyperus ferax* L. C. Rich.

EL VALLE: Near Buenaventura, No. *212*, May 8, 1929.

*351. UREDO PEPEROMIAE P. Henn. Hedwigia **38**: 69. 1899.

The name *Uredo Peperomiae* is used here with some doubt. Some workers have combined *U. Piperis* and *U. Peperomiae.* The original descriptions would indicate that there are differences. In any event this specimen on *Piper antioquiense* is quite different from *U. Piperis* on *Piper Hartwigianum.* The sori of this specimen are punctiform and have paraphyses, are chiefly hypophyllous, and dirty brown, whereas those of *U. Piperis* are without paraphyses, epiphyllous, and yellowish brown.

On *Piper antioquiense* C. DC.

EL VALLE: Above Cali, No. *461*, June 10, 1929.

*352. UREDO PIPERIS P. Henn. Hedwigia Beibl. **38**: 70. 1899.

This specimen has been compared with a specimen of *U. Piperis* from Brazil, (E. Ule, Mycotheca brasiliensis *26*) and with a specimen from Porto Rico determined by Arthur as *U. Piperis.* It agrees very well with these specimens. Thanks are due to Dr. Arthur for opportunity to examine these specimens.

On *Piper Hartwigianum* C. DC.

EL VALLE: Above Cali, No. *462*, June 10, 1929.

UREDO SCABIES Cooke, Grevillea **15**: 18. 1886.

On *Vanilla planifolia* Griseb.

Reported from Colombia by G. Lindau, Orchis **9**: 177. 1915.

UREDO THERESIAE Neger, Beih. Bot. Centralb. B. **13**: 78. 1903.

On *Crotalaria anagyroides* H. B. K.

TOLIMA: Quindio Pass, Andes Centrales, Therese de Baviere.

UREDO TERAMNI Mayor, Mem. Soc. Neuch. Sci. Nat. **5**: 587. 1913.

In Porto Rico this host has on it *Phakopsora Vignae* (Bres.) Arth. but the characters given by Mayor for the collection referred to here do not agree with that species and it is here listed as valid.

On *Teramnus uncinatus* (L.) Sw.
Antioquia: *Mayor*.

*353. **Uredo tolimensis** Kern and Whetzel sp. nov.

Uredinia hypophyllous, gregarious, in groups 0.2–0.8 mm. across on discolored spots, roundish or oval, 0.3–0.8 mm. across, rather early naked, cinnamon-grown, pulverulent, ruptured epidermis conspicuous; urediniospores broadly ellipsoid, 23–32 x 32–39 u, the wall brownish yellow, 3–3.5 u thick often with a slight hyaline umbo at apex, prominently and obliquely striate, the pores 2–3 equatorial.

The notable feature of this species are the markings on the urediniospore walls. They are conspicuous, rather closely set ridges, running obliquely across the spore. Sometimes the ridges anastomose but always run for considerable distances without branching. Markings of this sort are rather unusual.

On *Solanum* sp.
Tolima: Along Combeima River, near Ibagué. No. *569*, June 20, 1922. (type).

Uredo Torulini P. Henn. Hedwigia **44**: 57. 1905.
On *Torulinum ferax* (L. C. Rich) Urban.
Antioquia: *Mayor*.

*354. Uredo unilateralis Arth. Bull. Torrey Club **45**: 155. 1918.

This uredo is a rather unusual one having spores that are reniform or concave on one side and only one pore which is on the concave side and usually subequatorial. Our specimen has on it pycnia and aecia which evidently by their association are a part of the life cycle of the species. The pycnia are subepidermal, globose or flattened globose, 64–80 x 80–105 u, with ostiolar filaments 26–42 u long. The aecia are scattered, yellowish, bullate, 0.5–1 mm. across, caeomoid, tardily naked, the aeciospores globoid or ellipsoid, 19–26 x 23–32 u, with wall thin, 1–1.5 u hyaline, finely verrucose. A careful search has revealed no evidence of the telial stage.

The host, *Geranium mexicanum* H. B. K., here listed is the one reported by Mayor, p. 463, and referred to *Uromyces Geranii* (DC.) Ott. & Wartm. The Mayor specimen was collected in the same locality as the one on *G. hirtum*. Mayor's description of the urediniospores makes it very certain that his collection should be referred here rather than to *Uromyces Geranii*.

On *Geranium mexicanum H. B. K.*

CUNDINAMARCA: Ravine between Cerro Monserrate and Guadalupe above Bogotá, No. *596*, June 25, 1929.

On *Geranium hirtum* Willd.

CUNDINAMARCA: *Mayor.*

Otherwise known only from the type locality, Amecameca, Mexico.

UREDO VERNONIAE Mayor, Mem. Soc. Neuch Sci. Nat. **5**: 594. 1913.

On *Vernonia* cf. *mollis* H. B. K.

ANTIOQUIA: *Mayor.*

UREDO ZEUGITIS Arth. & Holw.; Arth. Am. Jour. Bot. **5**: 538. 1918.

On *Zeugitis mexicana* (Kunth.) Trin.

ANTIOQUIA: *Chardon.*

Known also from the type locality in Guatemala.

EU-BASIDIOMYCETES

L. O. OVERHOLTS *

The first account that included species of the higher Basidiomycetes of Colombia seems to have been made by Hooker (in Kunth, C. S. Synopsis Plantarum quas in itinere ad plagam aequinoctialem Orbis Novi collegerunt Al. de Humboldt et Am. Bonpland, 7–13 (Fungi). Paris. 1822). This list enumerated ten species of the group that were reported to have been collected in what is now the Republic of Colombia. Since it is impossible to verify these determinations at present they are here listed separately, without further comment other than that in parenthesis following some of the names.

Agaricus umbilicatus Hook (Probably *Lentinus crinitus* (L.) Fries).

Daedalea laevis Hook.

Boletus reticulatus Hook. (*Hexagona reticulata* (Hook.) Glotzsch).

Boletus tenuis Hook. (*Favolus tenuis* (Hook.) Fries).

Boletus fibrosus Hook. (*Trametes hydnoidea* (Sw.) Fries).

Boletus pavonius Hook. (*Polyporus pavonius* (Hook.) Fries.)

Boletus purpurascens Hook. (Identity uncertain).

Hydnum palmatum Hook.

Thelephora badia Hook. (*Stereum cinereo-badium* Fries).

Peziza nigrescens Sw. (*Hirneola nigrescens* (Sw.) Fries).

In 1863 Leveille listed (in J. Triana and J. E. Planchon, Prodomus Forae Novo-Granatensis (Cryptogamie) 151–169. Paris. 1863–1867) seventeen species of higher Basidiomycetes from Colombia. The list is as follows:

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* Contribution from the Department of Botany, Pennsylvania State College.

Marasmius ramealis Bull.
Lenzites myriophylla Lev.
Polyporus Lindigii Lev.
Polyporus hymeninus Lev.
Polyporus chryseus Lev.
Polyporus versiporus Pers.
Polyporus tenax Lev.
Polystictus floridanus Berk.
Polystictus candidus Lev.
Favolus granulosus Lev.
Radulum trachyodon Lev.
Stereum villosum Lev.
Stereum Goudotianum Lev.
Stereum vitelinum Lev.
Corticium roseum Fries.
Lycoperdon pyriforme Pers.
Bovista fusca Lev.

No other extensive list of Colombia have been made, although an exhaustive search of the literature would probably show that a few additional species have been reported.

The collections turned over to me by Dr. Chardon yield twenty-nine rather positive identifications. A few collections were impossible to identify due to one cause or another, but mainly attributable to the very scanty descriptions extant. It is of interest to note that the list recorded by Leveille contains not a single duplication of the species listed by Hooker, and further that the list here presented duplicates, so far as can be learned at present, only three species listed by Hooker and not a single species listed by Leveille. A study of Leveille's specimens would probably show some duplications, however, since the larger number of those he described are either known only from the original collection or are not to be considered as well known species under the name he applied to them.

HYMENOMYCETES

Family 1. AURICULARIACEAE

355. AURICULARIA AURICULA-JUDAE (Bull.) Schroet. Krypt. Fr. Schles. **3**: 38. 1889.

On fence post.

ANTIOQUIA: Pedrero, No. 86, May 25, 1926.

Family 2. DACRYOMYCETACEAE

*356. GUEPINIA FISSA Berk. Ann. Mag. Nat. Hist. **10**: 383. **1842.**

On dead wood.

EL VALLE: Cordillera Occidental, No. *500*, June 11, 1929.

This is a fine collection. Patouillard (Tab. Anal. No. 689. **1889**) gives spore measurements considerably shorter than in these specimens and infers that the spores are one-celled. This collection has spores 12–15 x 5–6 u, and distinctly 4–celled. His figure represents the species quite well, although the tips in these specimens are somewhat less lobed than in his figure.

*357. GUEPINIA SPATHULARIA (Schw.) Fries, Elench. Fung. **2**: **32.** 1828.

On dead wood.

EL VALLE: Zarzal No. 384, May 13, 1929.

SANTANDER: Puerto Wilches, No. *152*, June 18, 1926.

Family 3. CLAVARIACEAE

*358. PTERULA PLUMOSA (Schow.) Fries, Linnaea **5**: 532. 1830.

On dead bark.

EL VALLE: Cordillera Occidental, No. *738*, June 11, 1929.

Family 4. THELEPHORACEAE

*359. STEREUM AUSTRALE Lloyd, Myc. Writ. 4 Letter **48**: 10. **1913.**

On dead wood.

EL VALLE: 13 km. south of Cali No. *367*, May 14, 1929; Zarzal No. *386*, May 31, 1929.

Family 5. POLYPORACEAE

360. DAEDALEA REPANDA Pers.; Gaud. Voy. Freyc. 168. 1826.

On dead wood.

EL VALLE: Zarzal, No. *391*, May 31, 1929.

This collection is not typical of the species.

*361. FAVOLUS BRASILENSIS Fries, Elench. Fung. 44, 1828.

On dead wood.

EL VALLE: Between Cerrito and Palmira, No. *350*, May 23, 1929.

*362. FAVOLUS RHIPIDIUM Berk. in Hooker's London Jour. Bot. **6**: 319. 1847.

On dead wood.

TOLIMA: Ibagué, No. *565*, June 20, 1929.

363. HEXAGONA TENUIS (Hook.) Fries, Epicr. Syst. Myc. 498. 1838.
On dead wood.
EL VALLE: Between Cerrito and Palmira, No. *365*, May 23, 1929.
On dead limbs *Mangifera indica* L.
EL VALLE: 13 km. south of Cali, No. *366*, May 14, 1929.

*364. LENZITES STRIATA (Sw.) Fries, Epicr. Syst. Myc. 406. 1838.
On dead wood.
SANTANDER: Magdalena River, *144*, June 17, 1926.
CUNDINAMARCA: Along Funza River, *682*, July 11, 1929
EL VALLE: Zarzal No. *387*, May 31, 1929.

The plants in collection number 114 are thin and the lamellae rather close. Otherwise the agreement with the species is close. Specimens in number *682* are more typical, but decidedly gray on the upper surface. Number *387* is quite typical.

*365. POLYPORUS FIMBRIATUS Fries, Linnaea **5**: 520. 1830.
On dead wood.
EL VALLE: College N. S. de los Andes above Cali, No. 455, June 9, 1929.

In number *455* the hymenium is smooth toward the margin of the pileus and shows slight pore formation toward the base. *Hydnum multifidum* (Klotzsch) P. Henn. is a synonym, and collections are often more hydnoid than polyporoid.

*366. POLYPORUS GILVUS (Schw.) Fries. Elench, Fung. 104. 1828.
On dead wood.
EL VALLE: Cordillera Occidental, No. 501, June 11, 1929.

*367. POLYPORUS HIRSUTUS (Wulf.) Fries. Syst. Myc. **1**: 367. 1821.
On dead wood.
EL VALLE: Santa Ana No. *376*, May 20, 1929; Zarzal No. 465, May 31, 1929; Buenaventura, No. *224*, May 8, 1929.

*368. POLYPORUS LIGNOSUS Koltzsch, in Fries, Epicr. Syst. Myc. 471, 1838.
On dead wood.
SANTANDER: Magdalena River, No. *161*, June 18, 1926.

This species differs from *P. zonalis* Berk. to which it is often referred, in that the context hyphae are thin-walled, but 3–6 u diameter, and with frequent cross walls. In that species they are up to 9 u diameter, the walls are very much thickened, and no cross walls are present.

*369. POLYPORUS MAXIMUS (Mont.) Overtholts, Scientific Sur. Porto Rico & Virgin Isl. **8**: 164. 1926.

On dead wood.

CUNDINAMARCA: Juntas de Apulo, No. *691*, July 11–13, 1929.

A common species of the tropics. Usually large and thin and with the hymenium considerably toothed.

*370. POLYPORUS OCCIDENTALIS Klotzsch, Linnaea **8**: 486. 1833.

On dead wood.

SANTANDER: Magdaena River, near Puerto Wilches, Chardon No. *162*, June 18, 1926.

ANTIOQUIA: Pedrero, No. *87*, May 25, 1926.

Chardon's number 87 is immature and rembles *P. hirsutus*.

*371. POLYPORUS OMPHALODES Berk. Kooker's Long. Jour. Bot. **15**: 172. 1856.

On leaf mold in the forest, perhaps attached to buried wood.

SANTANDER: Magdalena River, No. *135*, June 15, 1926.

The specimens so referred have a smoky-isabelline, zonate, slightly pubescent, reniform pilous up to 2.5 cm. broad, on a slender vetutinate stem 3–8 cm. long, 1–3 mm. thick. Spores sub-globose, brown, not truncate, strongly echinulate, 10–12 u diameter. Lloyd says the spores of this species are smooth. The species was included in *Fomes*, along with other similar ónes, in Saccardo's Sylloge.

372. POLYPORUS PINSITUS Fries, Elench. Fung. 95. 1828.

On dead wood.

ANTIOQUIA: Ravine in Finca "Sorrento" Poblado, No. *46*, May 16, 1926.

EL VALLE: College N. S. de los Andes above Cali, No. *456*, June 9, 1929.

TOLIMA: Ibagué, No. *551*, June 20, 1929.

Chardon's numbers represent the form with pale colored hymenium. The form with the dark hymenium was not among these collections. The species is not always easily distinguished from *P. versicolor*. Number 551 is an intermediate form.

373. POLYPORUS SANGUINEUS (L.) Fries, Epicr. Syst. Myc. 444. 1838.

On dead wood.

ANTIOQUIA: Road from Pedrero to Fredonia, No. *88*, May 25, 1926.

SANTANDER: Magdalena River, No. 134, June 15, 1926.

EL VALLE: Buenaventura, No. *225*, May 8, 1929; Santa Ana, No. *337*, May 30, 1929.

Chardon's number 88 is hardly typical, lacking the smooth pileus surface usually so characteristic of the species and shown in all the other collections. It is hardly thick enough, however, for *P. cinnabarinus.*

A common species in the tropics.

*374. POLYPORUS VERSICOLOR (L.) Fries, Syst. Myc. **1**: 368. 1821.
On dead wood.
ANTIOQUIA: El Poblado, No. 79, May 20, 1926.
EL VALLE: College N. S. de los Andes above Cali No. *467* June 9, 1929.

*375. TRAMETES MOLLIS (Sommerf.) Fries, Hym. Eur. 583. 1874.
On fence post.
EL VALLE: Cordillera Occidental No. *503*, June 11, 1929.

376. TRAMETES HYDNOIDES (Sw.) Fries, Epicr. Syst. Myc. *190*, 1838.
On dead wood.
EL VALLE: Zarzal, *521*, May 13, 1929.

Family 6—AGARICACEAE

*377. PANUS RUDIS Fries, Epicr. Syst. Myc. 398. 1838.
On dead wood.
EL VALLE: San Pedro, north of Buga, No. *736*, June 4, 1929.

*378. PANUS STRIGELLUS (Berk. & Curt.) n. comb.
Lentinus strigellus Berk. & Curt., Jour Linn. Soc. **10**: 302. 1868.
On dead wood.
SANTANDER: Puerto Wilches No. *154*, June 18, 1926.

The gills are not serrate in the species. It appears like a small form of *Panus rudis* Fries.

*379. PANUS VELUTINUS Fries, Epicr. Syst. Myc. 398. 1838.
On dead wood.
SANTANDER: Puerto Wilches, No. *157*, June 18, 1926.
EL VALLE: Buenaventura, No. *223*, May 8, 1929.

While often referred to *Lentinus*, the species is better placed in *Panus* since the gills are not serrate.

380. SCHIZOPHYLLUM ALNEUM (L.) Schroet. Krypt. Fl. Schles. **31**: 553. **31**: 553. 1889.

On dead wood and on bamboo trunks.

EL VALLE: 13 km. south of Cali. No. *235,* May 14, 1929; near Cali, No. *308*, May 21, 1929; Zarzal No. *385*, May 31, 1929.

GASTEROMYCETES

Family 1—NIDULARIACEAE

*381. CYATHUS POEPPIGII Tul. Ann. Sci. Nat. III. **1**: 77. 1844.

On rich soil.

ANTIOQUIA: Medellín, No. *80,* May 21, 1926.

*382. CYATHUS STERCOREUS (Schw.) DeToni, in Sacc. Syll. Fung. **7**: 40. 1888.

On horse dung.

ANTIOQUIA: Medellín, No. *30,* May 8, 1926.

Family 2—LYCOPERDACEAE

*383. LYCOPERDON PUSILLUM (Blatsch) Fries, Syst. Myc. **3**: 33. 1821.

On the ground.

EL VALLE: Gardens at San Fernando, near Cali, No. *731,* May 18, 1929. (det. W. C. Coker).

*384. CALVATIA CYATHIFORMIS (Bosc.) Morgan.

On the ground.

CUNDINAMARCA: Wet meadows above Salto de Tequendama, No. *732,* July 6, 1929, (det. W. C. Coker).

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EXPLANATION OF PLATES

PLATE XXX

(Contributed by Dr. W. H. Weston, of Harvard University)

Synchytrium Phaseoli sp. nov.

A. Section of the stem of *Phaseolus vestitus* Hook. with the peripheral tissue showing numerous gall-like outgrowths surrounding the sori of the fungus. Mag. 15x.

B. Portion of a similar section, more highly magnified, showing immature galls not yet opened, in one a portion of the sporangial mass still remaining. Mag. 50x.

C. Galls more highly magnified showing their structure and relation to the superficial tissue of the stem. Mag. 75x.

D. Two galls, very superficial in this case, showing their relation to the host tissue, the structure of their walls, and a fragment of the delicate membranous, lining wall which surrounds the sorus of sporangia. Mag. 75x.

E. Sporangia, rounded out after being freed by the rupture of the gall, showing typical shapes and sizes. Mag. 500x.

F. Similar sporangia, recently cleaved out within the sorus, showing angular contour and flattened faces of contact. Mag. 500x.

G. Two sporangia of *Synchytrium aequatoriensis* Sydow for comparison showing their much larger size. Mag. 500x.

PLATE XXXI

(Contributed by Dr. W. H. Weston, of Harvard University)

Albugo Chardoni sp. nov.

A. Photograph of leaf of *Cleome anomala* H. B. K. showing the conspicuous pustules of the fungus chiefly at the bases and tips of the leaflets, scatteringly along the mid rib, with a few even on the petiole. x½ natural size.

B. Tip of an infected leaflet showing the conspicuous, crowded, erumpent pustules of the fungus, some of them already open, scattering masses of spores. Natural size.

C. A conidiophore from a pustule not yet emerged, still young, just beginning to form the first conidium. Mag. 500x.

D. A similar conidiophore with its conidium fully developed, and below it a collar-like zone looking as if the conidiophore were elongating by proliferation. Mag. 500x.

E. A developing conidiophore, the form and structure of which seem to indicate that proliferation is taking place. Mag. 500x.

F. Older conidiophore, bearing a conidium, recently formed and showing no differentiation of all thickness as yet. The conidiophore appears as if it had developed in successive segments by proliferating. Mag. 500x.

G. A similar conidiophore, the maturing conidium just beginning to show the differentiation in wall thickness. Mag. 500x.

H. A similar conidium, the wall now fully differentiated. Mag. 500x.

I. Mature conidiophores showing typical form and structure. Mag. 500x.

J. Terminal conidia showing characteristic size, structure, and thickness of wall. Mag. 500x.

K. Later conidia showing structural features and the distinctive wall thickening. Mag. 500x.

L. Copy of Lagerheim's figure of a conidium of *A. tillacae* with wall thickening of the same general type as that of *A. Chardoni.* Mag. unknown.

PLATE XXXII

A. Leaf of *Bromelia Pinguin* L. with lesions produced by *Peltella insignis sp. nov.* An ascus with spores.

B. *Asterina melastomatis* on *Miconia* leaf.

C. Showing distribution of *Placoasterina antioquensis gen. et. sp. nov.* on *Miconia desmantha* D. C.

D. Cross section of stroma showing arrangement of loculi in *Placoastorina antioquensis.* Toro.

E. Perithecium, ascus and spores of *Phaeostigme Isazanum sp. nov.*

F. A vermiform appendage of *Irene sororcula* (Speg.) Stev.

PLATE XXXIII

A. Leaves of *Tontanea canescens* (Willd.) Standley showing distribution of fungus *Irenina obtusa sp. nov.* A spore of fungus.

B. Leaf of *Miconia Toroi* Gleason showing red discolorations caused by *Asterina Uribei sp. nov.*

C. Showing necrotic lesions on leaf produced by *Asterinella antioquencis sp. nov.*

D. Distribution of *Asterina Bulluciae* on leaf.

PLATE XXXIV

(Photographs by W. R. Fischer, of Cornell University)

A. *Ulcodothis andina sp. nov.* on leaf of *Mikania Ruiziana.*
B. *Trabutia calarcana sp. nov.* on leaves of undetermined Malphigiaceae.
C. *Trabutiella Diazii sp. nov.* on leaves of *Machaerium sp.*
D. *Phyllachora Lasiacis* Sydow on leaf of *Lasiacis sp.*
E. *Sphaerodothis columbiensis sp. nov.* on leaf of *Penniscetum bambusiforme.*
F. *Phyllachora bonariensis* Speg. on leaves of *Guadua latifolia.*

PLATE XXXV

(Photographs by W. R. Fischer, of Cornell University)

A. *Phyllachora perlata* Sydow on portion of a leaf of *Polymnia eurylepis.*
B. *Camillea globosa* (Lev.) Lloyd on dead wood.
C. *Clypeotrabutia montserratis sp. nov.* on leaf of *Parscola coerula* (x5).
D. *Phyllachora Toroi sp. nov.* on leaves of *Cestrum lauriflrum.*
E. *Phyllachora vallecaucana sp. nov.* on leaf of *Buettneria sp.*
F. *Camillea cyclops* Mont. on dead wood.

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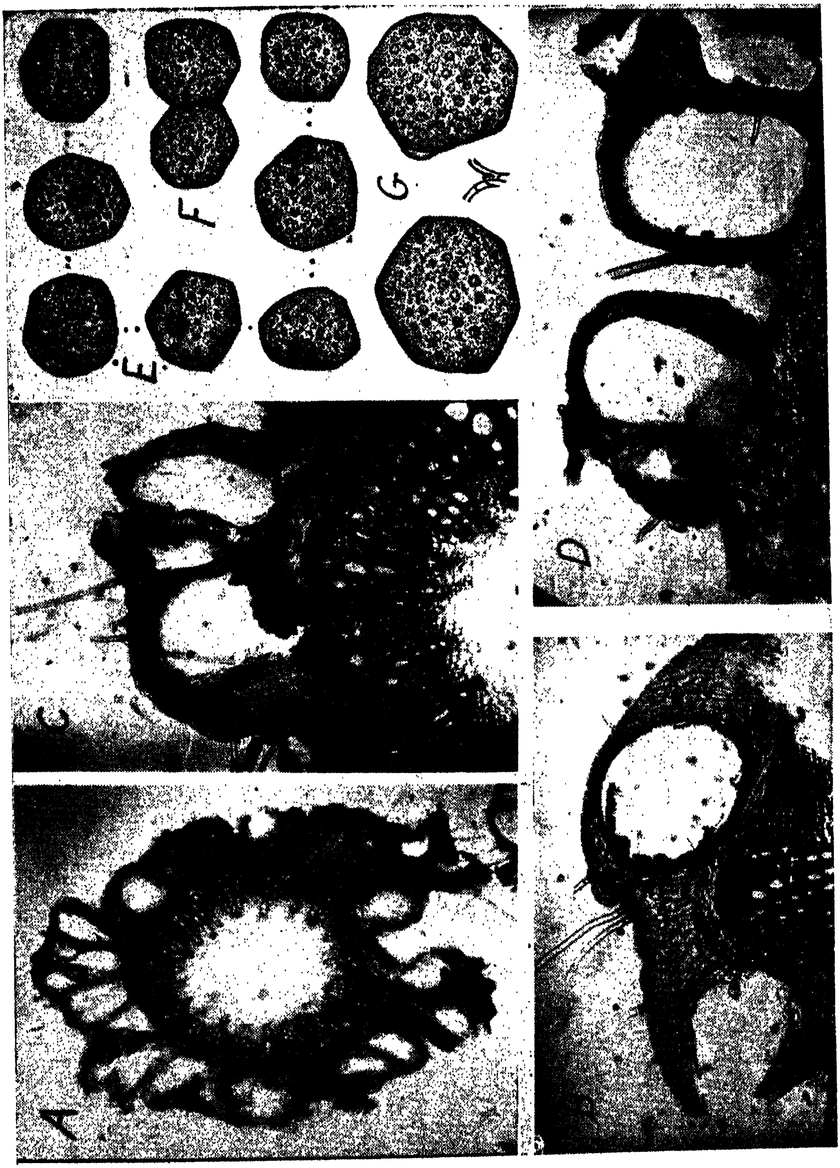

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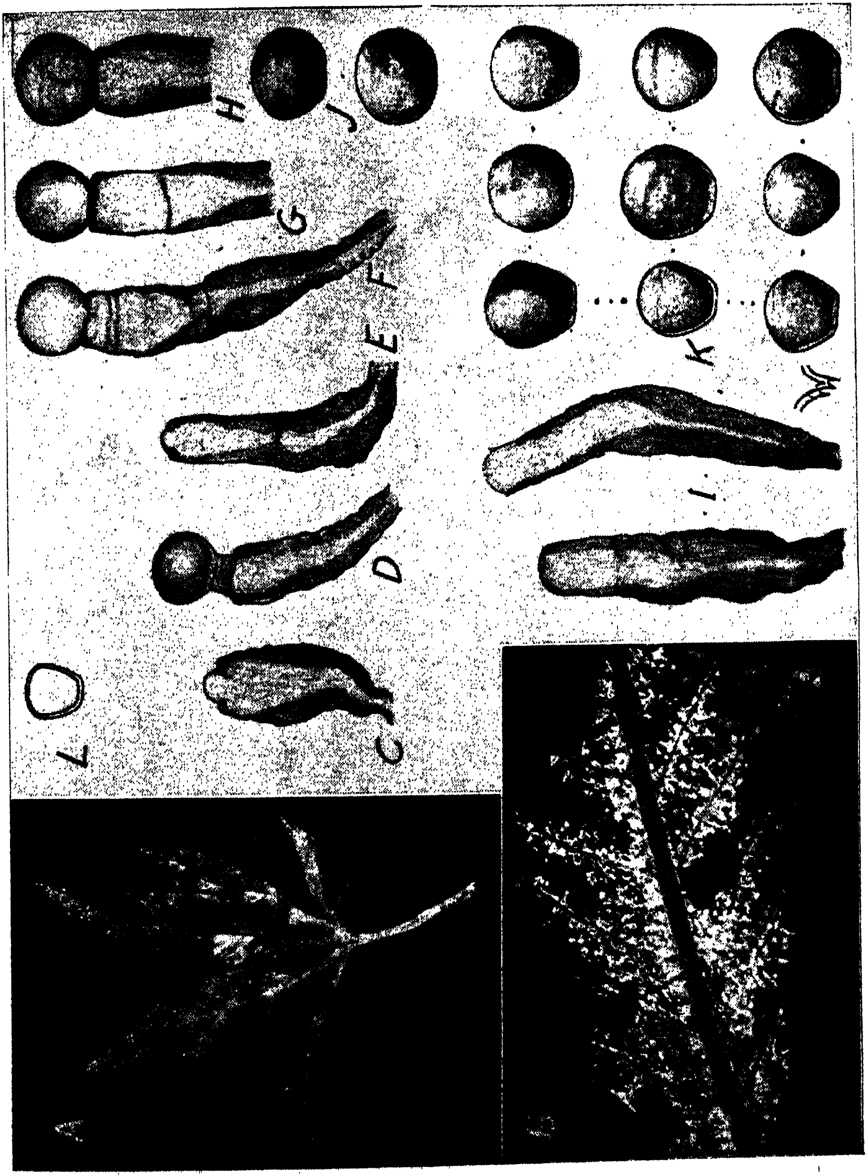

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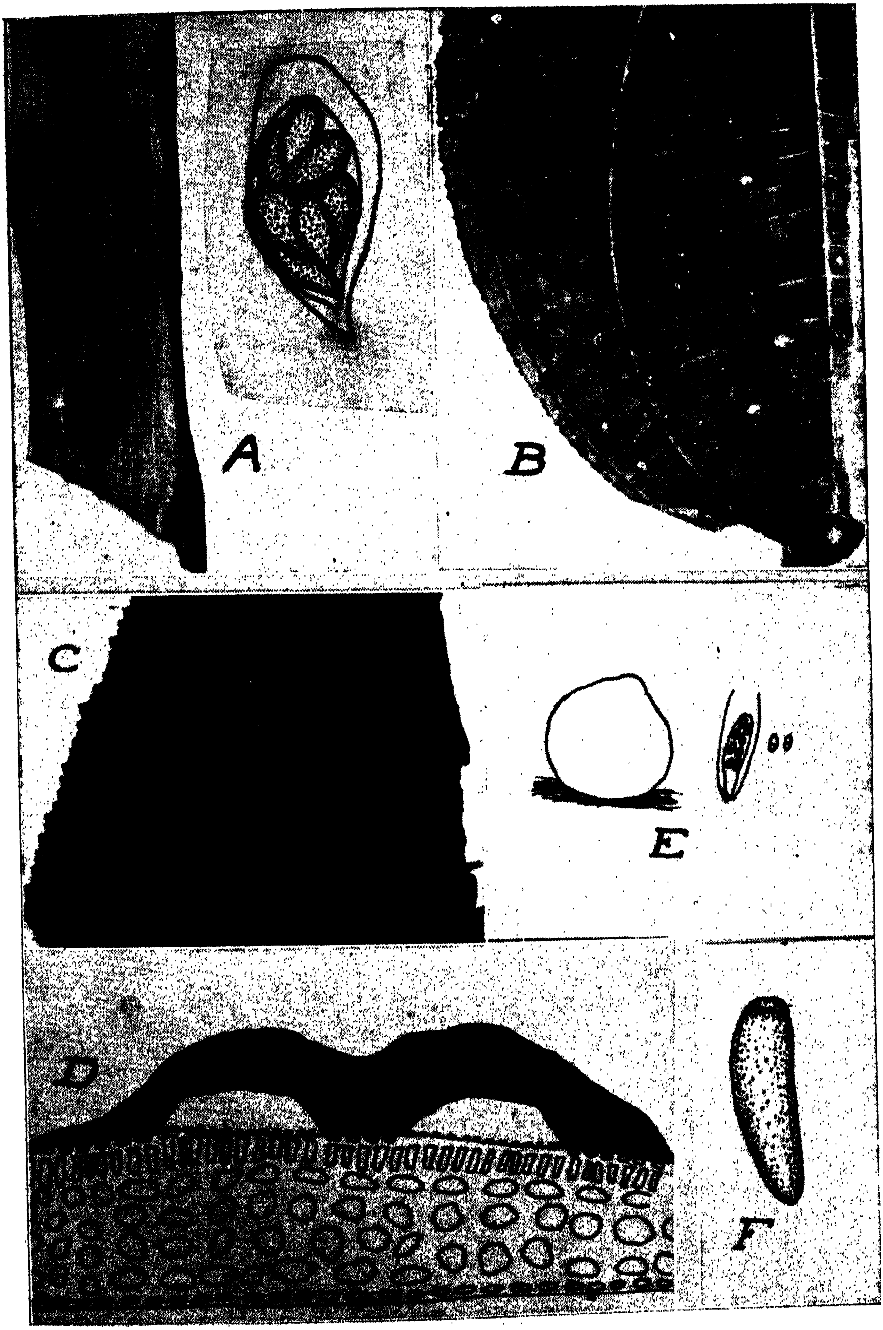

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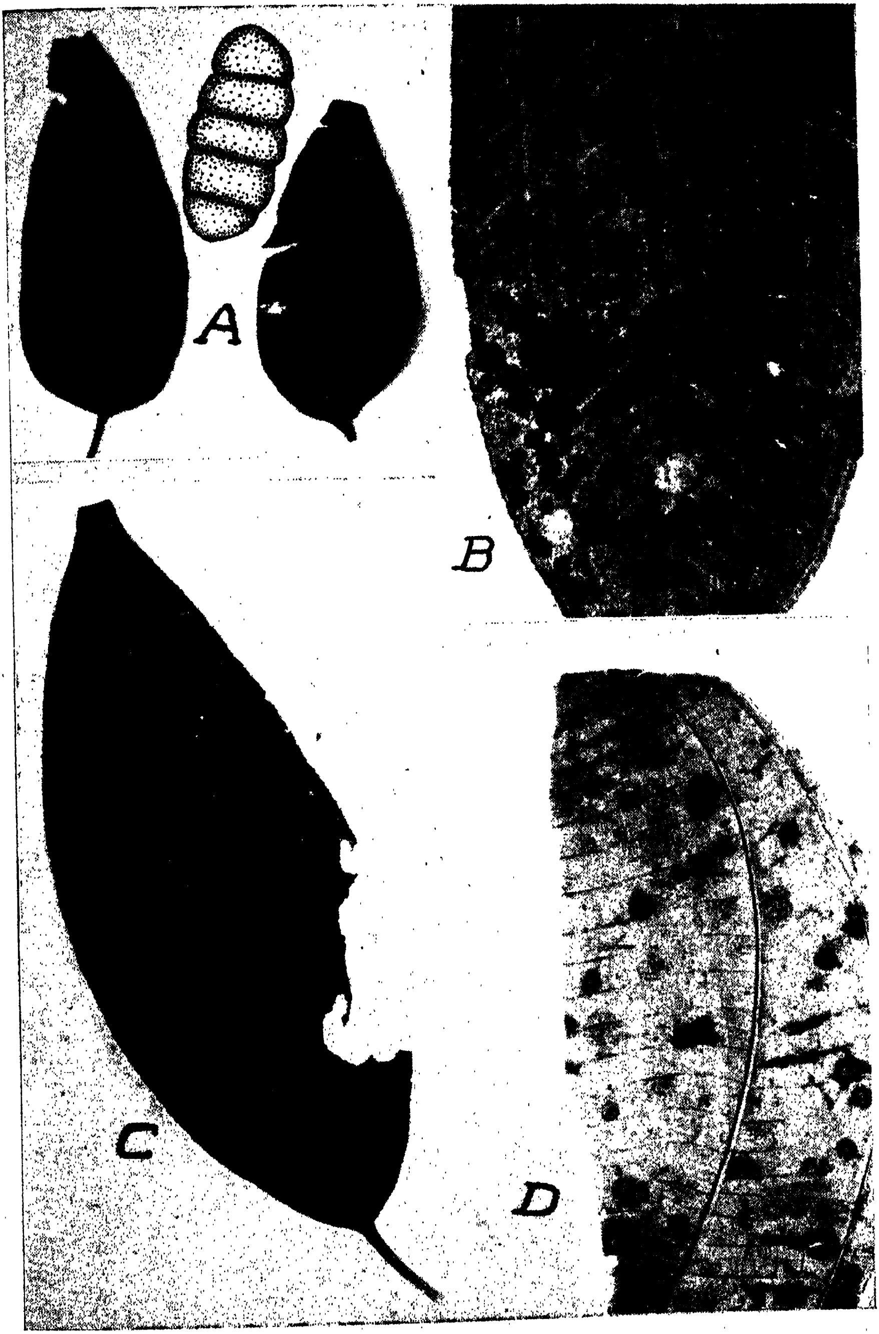

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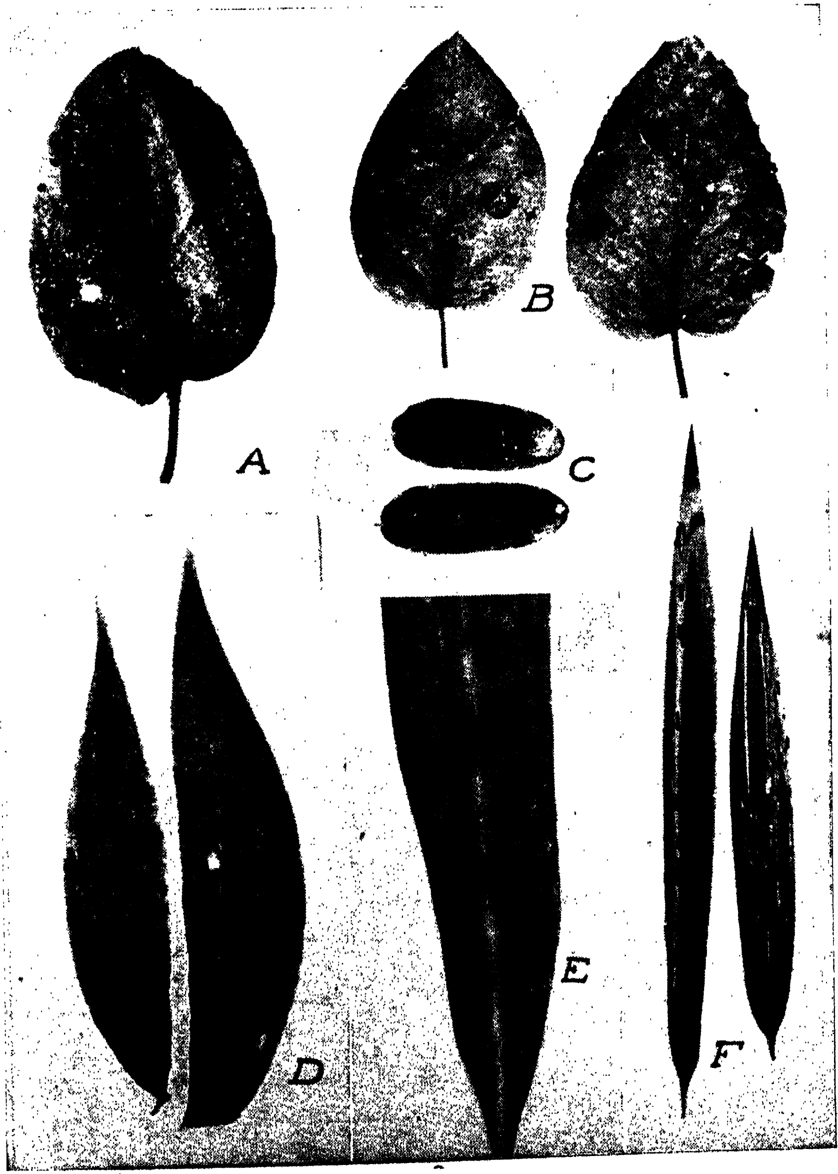

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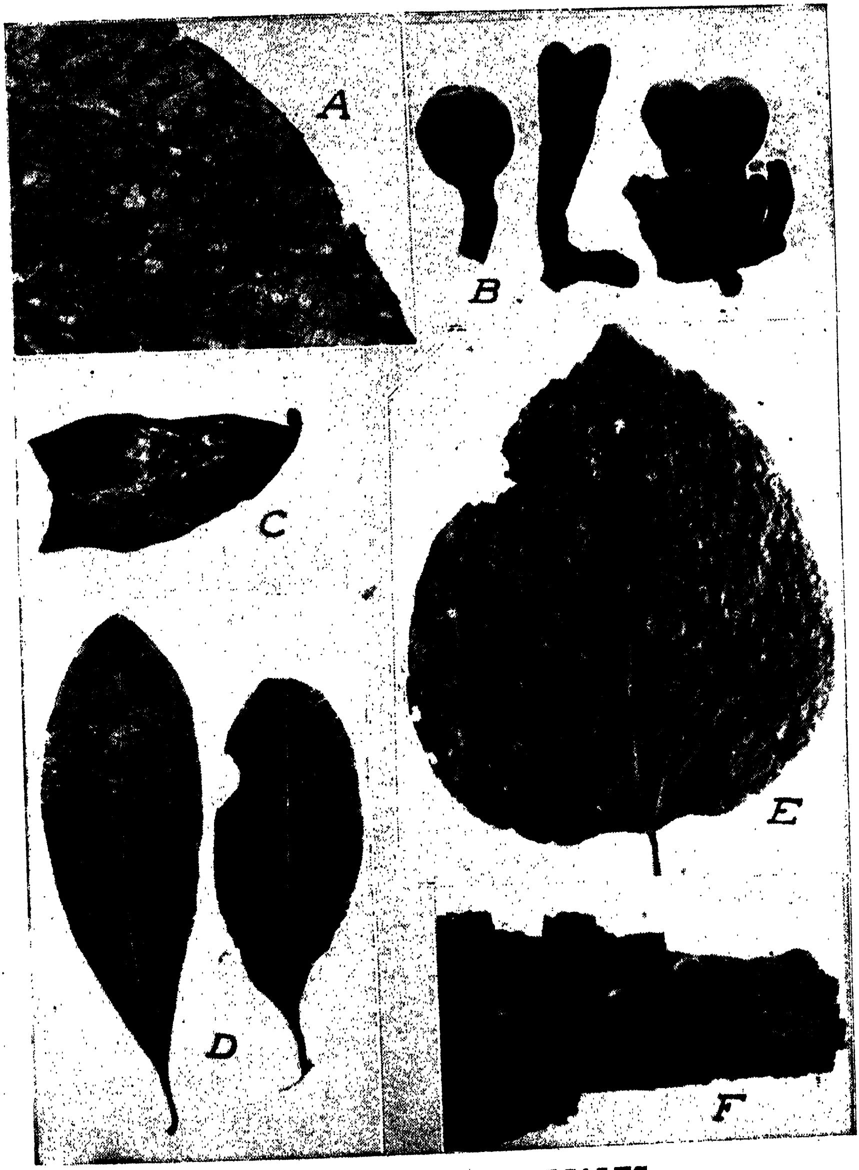

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